Vehicle body repairing

Level III

Based on November 2016, Version 2 Ethiopian Occupational Standard (EOS)

Module Title: - Carrying-outs advanced Welding Procedure

LG Code: EIS VBR3 M07 LO (1-3) LG(27-29)

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LG #27	LO1. Prepare for work

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Determining job requirements, including job sheets, quality and quantity of materials.
- Reading and interpreting job specifications
- Observing OHS requirements throughout the work.
- Selecting and inspecting Materials quality for repairs and replacements
- Identifying and checking hand, power tools, welding machines (TIG, MIG/MAG) and safety equipment
- Determining products to minimize waste material
- Identifying procedures for maximizing energy efficiency

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Determine job requirements, including job sheets, quality and quantity of materials.
- Read and interpret job specifications
- Observe OHS requirements throughout the work.
- Select and inspect Materials quality for repairs and replacements
- Identify and check hand, power tools, welding machines (TIG, MIG/MAG) and safety equipment
- Determine products to minimize waste material
- Identify procedures for maximizing energy efficiency .

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Determining job requirements, including job sheets, quality and quantity of materials.

1.1. Introduction to Material safety management systems

A safety management system (SMS) is a comprehensive management system designed to manage safety elements in the workplace. It includes policy, objectives, plans, procedures, organization, responsibilities and other measures. The SMS is used in industries that manage significant safety risks, including aviation, petroleum, chemical, electricity generation and others.

There are three imperatives for adopting a safety management system for a business – these are ethical, legal and financial. The safety management basic components are:

1. Policy Establish within policy statements what the requirements are for the organization in terms of resources, defining management commitment and defining occupational safety and health (OSH) targets

2. Organizing How is the organization structured, where are responsibilities and accountabilities defined, who reports to who and who is responsible for what.
3. Planning and Implementation What legislation and standards apply to our organization, what OSH objectives are defined and how are these reviews, hazard prevention and the assessment and management of risk.
4. Evaluation How is OSH performance measured and assessed, what are the processes for the reporting of accidents and incidents and for the investigation of accidents and what internal and external audit processes are in place to review the system.

5. Action for Improvement – How are preventative and corrective actions managed and what processes are in place to ensure the continual improvement process.

Material safety management is a scientific technique, concerned with Planning, Organizing & Control of flow of materials, from their initial purchase to destination.

1.2. Aim of material safety management system

To get

- The Right quality
- Right quantity of supplies
- At the Right time
- At the Right place
- For the Right cost

Purpose of material safety management system

- To gain economy in purchasing
- To satisfy the demand during period of replenishment
- To carry reserve stock to avoid stock out
- To stabilize fluctuations in consumption
- To provide reasonable level of client services

Economy in material management

- Containing the costs
- Instilling efficiency in all activities

Four basic needs of Material safety management system

1. To have adequate materials on hand when needed
2. To pay the lowest possible prices, consistent with quality and value requirement for purchases materials
3. To minimize the inventory investment
4. To operate efficiently

Basic principles of material safety management system

Effective management & supervision, It depends on managerial functions of

- Planning, Organizing, Staffing, Directing, Controlling, Reporting and Budgeting
- Sound purchasing methods
- Skillful & hard poised negotiations
- Effective purchase system
- Should be simple
- Must not increase other costs
- Simple inventory control program

Elements of material management

1. Demand estimation
2. Identify the needed items
3. Calculate from the trends in Consumption during last 2 years.

1.3. Materials handling

The National Safety Council suggests employers relay the following information to employees to help reduce workplace incidents when handling and moving materials:

- Avoid lifting materials from the floor or while seated.
- Make use of available handling aids.
- Refrain from using sudden or jerky movements.
- Never lift a load over an obstacle.
- Perform lifts in areas with adequate footing, space and lighting.
- Modify objects and redesign jobs to make moving easier.
- Seek assistance from co-workers.
- Stay in good physical shape.
- Begin lifts close to the body.
- Use containers made of lighter materials.
- Reduce load sizes when possible.
- Do not twist or bend while lifting objects.
- Ensure repetitive, heavy and bulky lifts are not performed.
- Keep lifts between shoulder and knuckle height.

- Use conveyors, slides or chutes to eliminate pushing or pulling.

1.4. Personal safety requirements (e.g. toxic fumes/lead poisoning)

Personal Safety refers to the freedom from physical harm and threat of physical harm, and freedom from hostility, aggression, harassment, and devaluation by members of the academic community. Safety includes worry about being victimized as well as actual incidents. The safety requirements are those requirements that are defined for the purpose of risk reduction. Like any other requirements, they may at first be specified at a high level, for example, simply as the need for the reduction of a given risk.

To be a welding technician, you will need:

- Good practical skills for using welding tools and equipments.
- The ability to work methodically and pay close attention to detail
- Good problem-solving skills
- The ability to read electrical wiring diagrams
- The ability to work alone and as part of a team
- Good communication and customer care skills
- The ability to keep up to date with developments in oxy acetylene welding technology
- An awareness of health and safety.
- Good ventilation in the work place.
- Brightness working area
- Appropriate clothing

When welding:

- Always wear protective clothing, i.e. flame retardant overalls.
- Always wear the correct eye goggles.
- Always have the spindle key in the acetylene cylinder valve.
- Always keep cylinders secured in an upright position.
- Always check for leaks with a soapy solution, NEVER with a naked flame.
- Never carry out makeshift repairs on welding equipment.
- Never allow oil or grease to come in contact with oxygen equipment.

- Never weld an enclosed vessel, i.e. petrol / oil drums until they have been thoroughly cleaned.
- Never work in an enclosed vessel on your own and always leave the cylinders outside. If working in an enclosure vessel, adequate ventilation should be provided and fire-fighting equipment should be available.
- In the event of a serious flashback or backfire plunge the blowpipe in a bucket of cold water, leaving the oxygen running to prevent water entering the blowpipe.
- Should the hoses become damaged, turn off the supply of gas at the cylinder and inform your instructor.
- Don't forget, this equipment, if misused or damaged, can be dangerous. If in any doubt seek assistance and clarification from your instructor.

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided or on the separate answer sheet (5 pts)

If working in an enclosure vessel, adequate ventilation should be provided(2 pts)

minimize the inventory investment is one of Material safety management system(3 pts)

Instruction II:- Ddiscuses or write the answer for the following questions (10 pts)

List Personal safety requirements inwelding (2pts)

Define Materials handling (4 pts)

List the Aim of material safety management system (4 pts)

Note: **Satisfactory rating >=7.5 points** **Unsatisfactory < 7.5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 2- Reading and interpreting job specifications

2.1 Definition of Job Specification

A job specification defines the knowledge, skills and abilities that are required to perform a job in an organization. Job specification covers aspects like education, work-experience, Managerial experience etc. which can help accomplish the goals related to the job. Job specification helps in the recruitment & selection process, evaluating the performance of employees and in their appraisal & promotion. job specification and job description help in giving a overview of the job in terms of its title, position, roles, responsibilities, education, experience, workplace etc.

2.2 Importance of Job Specification

The importance and purpose of job specification is a thoroughly understand the specific details of a job. Jobs can be of different types and can require a different skill sets to get the maximum output from a particular.

Gives important details related to the job like education & skills, prior work experience, managerial experience, personality traits etc which would help an employee accomplish the objectives of a job.

For a recruiter, job specification lays down the guidelines basis of which the company can recruit and select the best possible candidate who would be best suited for the job. Apart from actually finding the right candidate or employee,

Used for screening of resumes & short list only those candidates who are the closest fit to the job.

Gives specific details about a job and what kind of skill sets are required to complete the job.

2.3 Components of Job Specification

There are many parameters which are considered while giving the job specification for a certain profile.

1. Educational Qualification: This parameter gives an insight on how qualified a certain individual is. It covers their basic school education, graduation, masters degree, other certifications etc

2. Experience: Job specification clearly highlights the experience required in a particular domain for completing a specific job. It includes work experience which can be from a specific industry, position, duration or in a particular domain. Managerial experience in handling and managing a team can also be a job specification criteria required for a particular position

3. Skills & Knowledge: This is an important parameter in job specification especially with knowledge and skill based profiles. The higher the position in a company, the more the skills become and more is the knowledge required to perform the job. Skills like leadership, communication management, time management, team management etc are mentioned.

4. Personality traits and characteristics: The way in which a person behaves in a particular situation, handles complex problems, generic behaviour etc are all covered in the characteristics of a job description. It also covers the emotional intelligence of a person i.e how strong or weak a person is emotionally.

Job Specification Example

Here is a sample job specification, which is prepared for an operating manager in an automotive campany.

Table 1 sample of job specification

Education	Must be an engineer and MSC in automotive for a reputed MSC institute
Work experience	Must have prior work experience in operating marketing and managerial (preferably in automotive industry)
Skills & Knowledge	Must be a good communicator and must be able to lead a team. Prior experience in handling operting activities and managing promotional events. Must be able to handle social media like Facebook, Twitter and help build online brand Experience in operational maneging Strong analytical skills and problem solving skills Must understand business, come up with innovative products and launch them
Personality Traits & Characteristics	1. Must be presentable and a good orator 2. Should be calm in complex situations and show leadership skills in managing multiple teams 3. Should be emotionally strong and should give timely deliverables

The above table is a sample of job specification. More specific details can also be put to give a better understanding about the job..

2.4 Advantages of Job Specification

There are several benefits of having a comprehensive job specification. Some advantages are listed below:

Job specification highlights all the specific details required to perform the job at its best

It gives the HR managers a threshold and a framework on the basis on which they can identify the best prospects

Helps in screening of resumes and saves time when there are multiple applications by choosing those who are closest to the job specification

HR managers can used job specification as a benchmark to evaluate employees and give them required trainings

It also helps companies during performance appraisal and promotions

2.5 Limitations of Job Specification

As we know, job specification arises from the job description; it also has some related problems. Let us have a look at those limitations:

Change in technology impacts the requirement of the company, i.e. changing of skills, qualification, experience, knowledge needed to execute the roles and responsibilities properly.

A job specification is a lengthy process and requires complete knowledge of the job position.

2.6 Difference and Comparison of job specification and job description

Table 2 Difference and Comparison of job specification and job description

BASIS	JOB DESCRIPTION	JOB SPECIFICATION

BASIS	JOB DESCRIPTION	JOB SPECIFICATION
Meaning	Job description is the written document in which all the information regarding a particular job including role, responsibilities and duties is summarized in a systematic manner.	Job specification is the set of specific qualities, knowledge and experience, a person must possess to perform a particular job.
Origin	Originates from Job Analysis	Based on Job Description
Elements	Consist of job title, job location, role, responsibilities, duties, salary, incentives and allowances	Involves personal attributes, skills, knowledge, educational qualification and experience
Objective	Describes the job profile	Specifies the eligibility criteria
What is it?	What the company is offering to the candidate.	What the company is demanding from the candidate.
Application by Human Resource Manager	Used to give the sufficient and relevant information of the job	Used to match the right attributes with the job so described

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction :Ddiscuses or write the answer for the following questions（10 pts)

Explain job specification (2pts)

List four components of job specification (4 pts)

Explain the difrence between job specification and job discrpition(4 pts)

Note: **Satisfactory rating >=5 points** **Unsatisfactory < 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 3- Observing OHS Requirements Throughout The Work.

3.1 Occupational Safety

Safety means protecting yourself and others from possible danger and injuring in the shop, you are ' Safe' when you protect your eyes, your fingers, your hands all of yourself from danger as well as others.

Safety is a critical consideration for any welding project. TIG,MIG/MAG and SPOT welding is a safe occupation when proper precautions are taken. But, if safety measures are ignored, welders face an array of hazards which can be potentially dangerous, including electric shock, fumes and gases, fire and explosions and more.

Work Shop Safety

The preparation of work shop to supply equipment helps to :

Keep environment well being.

Finish with specified our time pre-summing.

Identify the work and its implementing tools and equipment.

Decide the work procedure.

Keep tools, equipment and resource prevent ourselves from injury.

Done the work with quality.

3.1.1. Hazards in the work shop

i. Faulty work habits

Smoking around fuel and solvents,Incorrect handling of paint, thinners, solvents, flammable liquids etc..

Blocking exits. A block exit could mean serious injury or even death during an emergency case such as fire.

ii. Misuse of equipments

Incorrect safety guarding of moving machinery.

Misuse of flexible electric cords or worn cords. When used through holes the may cause fire.Improperly stored composed gas cylinders.Using hand held electric tools improperly grounded.

iii. Misuse of hand tools

- Keeping hand tools dirty and in poor conditions.
- Improper storing of hand tools.
- Using defective hand tools.
- Keeping sharp tools in pockets etc.

3.1.2. Environmental condition

- Free from flammable things.
- Events around the work campus is closer together.
- Climatic condition.
- Working area events.
- The vehicle should park on the level surface to repair the system.
- It should be wide for servicing.

3.1.3. Fire Prevention

- Store fuels properly.
- Keep the shop doors open, will ventilation where fuel vapours can exit.
- Wipe up the spilled fuel at once and keep the rags in a closed waste containers.
- Never smoke or light a cigarette around fuels. (Do not smoke in the workshops!).
- Fix leaking carburetors, fuel pumps fuel lone and fuel tank immediately.
- Make fire extinguishers available in the workshop and know perfectly well how to use them in case of fire.

3.2. Prsonal Safety

Any body who is involved in automotive body work activity should be aware of the following usingPersonal protective equipment (PPE)

- Protective clothing
- Skin care (personal hygiene systems)
- Hand protection
- Head protection
- Eyes & Face protection
- Foot protection
- Ear protection
- Respiratoryprotection (Lungs)

Table 3 Personal protective clothes

	Safety glasses must be worn at all times in work area!
	Respirator with HEPA filters must be worn when working with materials that give off harmful fumes
	Work Boots must be worn at all times when working in an area where there is risk of serious foot injury due materials falling onto the foot.
	Work Gloves should be worn when there is a risk of hand injury during the course of work tasks.

	Hard hats must be worn when working in an environment where there is a risk of objects falling from above or where there is a high risk of striking your head on objects.
	Close fitting clothing or protective clothing must be worn.

Note

Do not wear rings or other jewellery because Most of the dangers for an auto mechanic involve a running parts, road tests, etc.

Do not wear clothing made from synthetic or synthetic blends. The synthetic fabric can burn vigorously, melt and produce bad skin burns.

3.2.1. Working with chemicals

- Know where the fire extinguishers and fire exits are:-
- Do not get in to confined area with a carbon tetrachloride type extinguishers
- Make sure that there are no oil leakage on your working area.
- Do not smoke around a battery being charged. It gives off hydrogen which is extremely explosive.
- Avoid battery acid from setting in to your eyes or touching your skin.
- When mixing acid always pour slowly the acid in to the water the reverse mixing procedure may cause the mixture to boil and spatter with the force of apparent explosion
- The instruction for using any equipment should be studied carefully before the equipment is operated

- Hands and clothes should be kept away from the running machineries
- Disconnect the power source when you stop working on machines
- Clean, lubricate and cover the machine every time you finish working
- Never get under a vehicle which is standing on a jack. Support it with car stands and chock the wheels to keep the car from rolling
- Always use your legs and not and shoes while you are working in the shop

3.2.2. First Aid

- Give first aid whenever required using the first aid kit available in the shop
- Depending on the type of accident, call for help (doctor or ambulance).
- Observing dangers associated working with welding
- Any person involved in welding processes must take every precaution to ensure that the risk of starting a fire is minimized. Your part in minimizing the risk of starting a fire is made when you do the following:

Remove, wherever possible, any flammable material from the area.

This would include such items as:

- Paper.
- Oil or fuel drums.
- Paintcontainersand associated
    - products.
- Wooden articles.
- Fabrics.
- Plastics and associated materials.

- If you have to weld in areas that have "fixed" flammable materials, such as wooden floors then take the time to protect from possible ignition by "wetting down" the area using water.
- Always make sure that there is a fire extinguisher available nearby.
- Place a metal tray filled with sand beneath the work area. This is to catch any "slag" that might drop as you work. This practice will be essential if you are "flame cutting".
- During the working process you will always need to be aware of fire hazards.

- If there are workers around you ask them to keep an eye on the area. If you are working alone make it a habit to "look around" every few minutes in order to assess the area..
- Be sure your path is free of parts or tools.
- Be sure the container is in good condition.
- Straighten your legs to lift the object.
- If necessary, turn your whole body, don't twist your body.
- Bend your legs to lower the object.
- Place suitable blocks under the object

3.3. Tools,equipment and material safety

3.3.1. Hand Tool Safety

- use tools only designed for the purpose.
- Use a box end wrench or socket whenever possible.
- Use only impact sockets with impact wrenches.
- Never use pliers to loosen or tighten.
- Never use screwdrivers as chisels.
- Never strike two hammers together.
- Do not use hammers & files with split, loose or no handles, as they can cause serious injuries.
- do not use chisels or punches with mushroom heads as chips of metal can fly off the head.
- Using machines
- You need to understand how to use machines in the workshop before you handle them in practice. There are specific precaution suchas:-
- Keep fingers and clothing away from rotating equipment.
- Sanding and buffing wheels must be securely attached.
- Protective guards must be in place.

- Wear safety glasses or a face shield.
- Follow the tool manufacturer's directions

Must be observed when you are using the following machines:

- Drilling machine
- Welding machine(MIG/TIG and Spot welding machine)
- Grinding machines
- Air tools & compressor
- Rolling machines
- Metal cutting machine
- Sanding machine
- Body jack (hydraulic

3.3.2. Material safety

A number of materials are used in a work shop .Materials like fuel, paint and solvents (e.g. Thinners) and other flammable liquids need safety. Incorrect handling of these materials may causes hazard in the shop. So that it is better to put these materials in safe storage area.

Note:-

1. 1.Store fuels and other flammable liquids properly.
2. Keep the shop doors open, for the fuel vapors to Exit.
3. Wipe up the spilled fuel at once and keep the rags In a closed waste containers.
4. Never smoke or light a cigarette around fuels. (Do Not smoke in the workshops!).
5. Keep sheet metals and steel pipe in dry area.

Whenever you deal with TIG, MIG/MAG dnd spotwelding operation it is better to be aware of the following work instructions prepare the necessary materials for welding

Be aware of how to use welding materials, equipments and tools Make a necessary measurements[if required.Get information how to do the work[consult the manual

Perform the welding operation.

Table 4 potential Health & Safety Hazards

HAZARD		TO PROTECT YOURSELF
EXPLOSIVE		Make sure volatile chemicals are stored and handled correctly. Proper grounding must be used for all containers.
HIGH SOUND LEVELS Sound levels exceed 85 dB		HEARING PROTECTION is required when working in designated areas.
EXPOSURE		Understand the chemical(s) you are working in the vicinity of. Consult the MSDS and wear the appropriate PPE.
FOOT INJURY		Approved protective footwear is needed when there is the risk of foot injury due to slipping, uneven terrain, abrasion, crushing potential, temperature extremes, corrosive substances, puncture hazards, electrical shock and any other recognizable hazard
COMPRESSED GASES		Do not • drop • keep near heat
FIRE Due to flammable liquids, gases or combustible dusts		Complete a hot work permit work requires it.

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the space provided answer sheet

Instruction :- Ddiscuses or write the answer for the following questions (14 pts)

Mention at least four personal protective equipment (4 pts)

List Hazareds in the work shop (4 pts)

What do you think, if safety measures are ignored in MIG/MAG and TIG welding (6 pts)

Instruction II: - write true if the statement is correct , write false if the statement is incorrect and write the answer on the space provided or on the separate answer sheet (6 pts)

During the working process you will always need to be aware of fire hazards. (3 pts)

Misuse of equipments IS Incorrect safety guarding of moving machinery(3 pts)

Note: **Satisfactory rating >10= points** **Unsatisfactory <10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 4- Selecting and inspecting Materials quality for repairs and replacements

4.1. Material selection

It is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to minimize cost while meeting product performance goals. Systematic selection of the best material for a given application begins with properties and costs of candidate materials. It is essential that a designer should have a thorough knowledge of the properties of the materials and their behavior under working conditions. Some of the important characteristics of materials are : strength, durability, flexibility, weight, resistance to heat and corrosion, ability to cast, welded or hardened, machinability, electrical conductivity, etc.

Material selection in the automobile industry is an artful balance between market, societal, and corporate demands, and is made during a complex and lengthy product development process. Actual selection of a particular material for a specific application is primarily driven by the trade-off between the material's cost (purchase price and processing costs) and its performance attributes (such as strength and durability, surface finish properties, and flexibility.) The vehicle manufacturers' materials engineer and component-release engineer play the pivotal role in screening, developing, validating, and promoting new materials, although initial consideration of possible material changes may be sparked by numerous players. These selection decisions are made within a material selection process that will continue to evolve. This evolution will largely reflect changes in the vehicle and component development processes to make them more responsive-in terms of accuracy, time, and cost-to market and regulatory demands. The balancing of market, societal, and corporate demands will continue to determine specific automotive material usage in the future.

4.2. Material Inspection

Inspection is an important tool to achieve quality concept. It is necessary to assure confidence to manufacturer and aims satisfaction to customer. Inspection is an indispensable tool of modern manufacturing process. It helps to control quality, reduces manufacturing costs, eliminate scrap losses and assignable causes of defective work.

The inspection and test unit is responsible for appraising the quality of incoming raw materials and components as well as the quality of the manufactured product or service. It checks the components at various stages with reference to certain predetermined factors and detecting and sorting out the faulty or defective items. It also specified the types of inspection devices to use and the procedures to follow to measure the quality characteristics.

Inspection only measures the degree of conformance to a standard in the case of variables.

In the case of attributes inspection merely separates the nonconforming from the conforming.

Inspection does not show why the nonconforming units are being produced.

Inspection is the most common method of attaining standardization, uniformity and quality of workmanship.

4.2.1. Purpose of Inspection

- To distinguish good lots from bad lots.
- To distinguish good pieces from bad pieces.
- To determine if the process is changing.
- To determine if the process is approaching the specification limits.
- To rate quality of product.
- To rate accuracy of inspectors.
- To measure the precision of the measuring instrument.
- To secure products-design information.
- To measure process capability.

4.2.2. Methods of Inspection

There are two methods of inspection. They are: 100% inspection and sampling inspection.

1. 100% inspection

This type will involve careful inspection in detail of quality at each strategic point or stage of manufacture where the test is involved is non-destructive and every piece is separately inspected.

It requires more number of inspectors and hence it is a costly method. There is no sampling error. This is subjected to inspection error arising out of fatigue, negligence, difficulty of supervision etc. Hence, completer accuracy of influence is seldom attained. It is suitable only when a small number of pieces are there or a very high degree of quality is required. Example: Jet engines, aircraft, medical and scientific equipment.

1. Sampling inspection

In this method randomly selected samples are inspected. Samples taken from different patches of products are representatives. If the sample proves defective, the entire concerned is to be rejected or recovered. Sampling inspection is cheaper and quicker. It requires less number of Inspectors. It is subjected to sampling errors but the magnitude of sampling error can be estimated.

In the case of destructive test, random or sampling inspection is desirable. This type of inspection governs wide currency due to the introduction of automatic machines or equipments which are less susceptible to chance variable and hence require less inspection, suitable for inspection of products which have less precision importance and are less costly. **Example**: Electrical bulbs, radio bulbs, washing machine etc**.**

2. Drawbacks of Inspection

Following are the disadvantages of inspection:

- Inspection adds to the cost of the product but not for its value.
- It is partially subjective, often the inspector has to judge whether a products passes or not.
- Fatigue and Monotony may affect any inspection judgment.

- Inspection merely separates good and bad items. It is no way to prevent the production of bad items.

Self-Check -4	**Written Test**

Directions: Answer all the questions listed below. Use the space provided .

Instruction :- Ddiscuses or write the answer for the following questions (13 pts)

1. List the important characteristics to select materials (4 pts)

2. Write down the advantages of material selection in welding processe (4 pts)
3. List out at list 3 purposes of Inspection.(5 points)

4. **Instruction I: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (_7_ pts)**

1._____ is an important tool to achieve quality concept. (1 points)

A. 100% inspection C. Material

B. Local maps D. inspection

Note: **Satisfactory rating >=10 points Unsatisfactory<10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 5- Identifying and checking hand, power tools, welding machines (TIG, MIG/MAG) and safety equipment

5.1. Hand, power tools, welding machines (TIG, MIG/MAG) and safety equipment

5.1.1. Equipments required

Welding machine ,Work cable ,clamp assembly,Welding gun ,Wire feed,cableassembly

Figure 1 welding machine

Figure 2 welding preasure gage

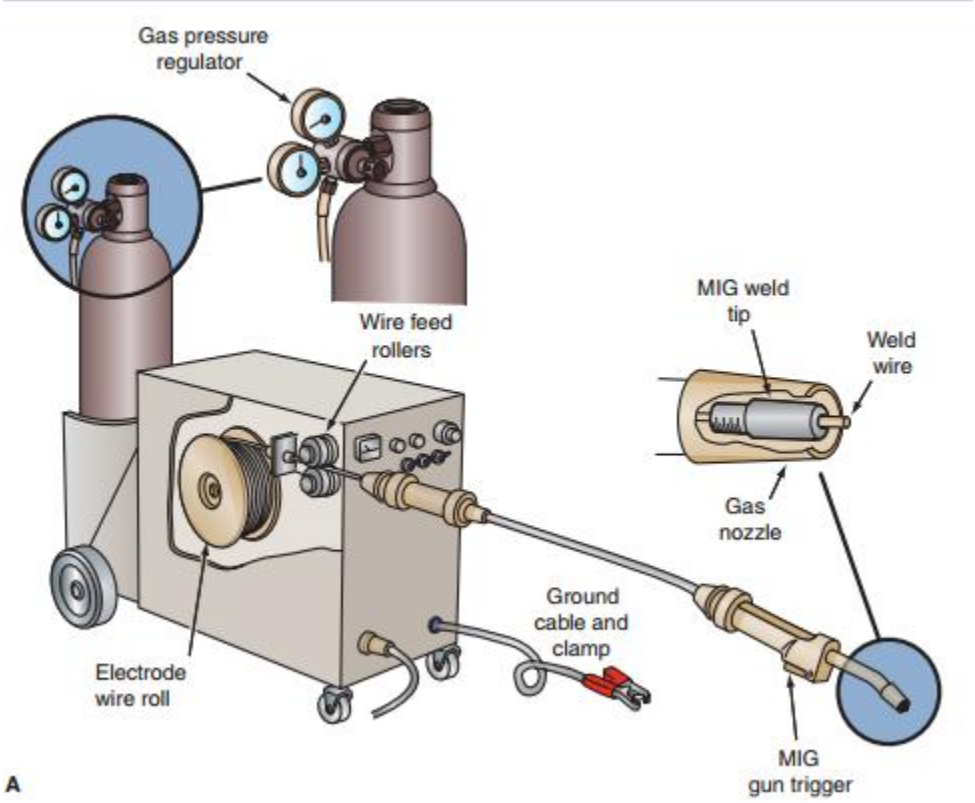


Figure 3 welding component

Figure 4 spot welding dent puler

5.1.1. Tools required

Face shield

Hammers

Hand Gloves

Goggle

5.1.2. Materials required

Panels of different sheet metals

-Aluminum sheet metals

-Steel sheet metals

Supply of shielding gas with a flow regulator

Filler Wire

Electrode wire of a specified type & diameter

Self-Check -5	**Written Test**

Directions: Answer all the question listed below. Use the space provided .

Instruction :- Ddiscuses or write the answer for the following questions (10 pts)

1. List the required Equipments, Tools and Materials for TIG, MIG/MAG welding(10pts)

Note: **Satisfactory rating >=5 points** **Unsatisfactory <5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 6- Determining products to minimize waste material

6.1 Waste management and disposal

Waste management is the collection, transport, processing or disposal, managing, monitoring and regulation of waste materials. The term usually relates to materials produced by human activity, and the process is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. The management of wastes treats all materials as a single class, whether solid, liquid, gaseous or radioactive substances, and tried to reduce the harmful environmental impacts of each through different methods. Waste types may include solid (non-hazardous) e.g. construction and demolition liquid (non-hazardous) e.g. chemical and aqueous hazardous,regulated, prescribed, quarantined, medical and clinical Recoverable resources e.g. recyclable and green waste.

6.2 Waste management techniques

It was away of eliminating or utilizing waste in to use able form through the following techniques.

a) Waste reduction (or prevention)

Waste reduction (or prevention) is the preferred approach to waste management because waste that never gets created doesn't have waste management costs. An example of waste reduction is reducing unnecessary packaging from manufactured products and produce. If this excess packaging could be avoided, no one would have to be concerned with the cost and effort of collecting the excess packaging, separating it for recycling, breaking it down, transporting it to manufacturers, and then integrating the recycled

materials back into the manufacturing process. Waste reduction also helps conserve resources for future generations and contributes to a cleaner environment

b) Waste reuse

Reuse refers to checking, cleaning or repairing recovery operations, by which products or components of products that would have become waste are prepared so that they can be re-used without any other pre-processing. Preparing for re-use therefore implies changes in practices; both in terms of consumer purchasing habits and in terms of the manufacturing process. Waste can be used as source of fertilizer or alternative energy sources (biogas or fuel wood).The consistency of manure is usually classified as solid, semisolid, slurry or liquid, depending on its fluidity. Animal manure most be handled properly so that odours, dust, flies, rodents, and other nuisances are controlled. The system of waste handling must not allow the waste to be dumped in to streams, rivers, lakes, or reservoirs.

c) Waste audit

Waste audit is referred to as an examination of the amount and type of waste a particular organization receives. There are many types of waste that will be researched during the Waste Audit project such as paper, municipal waste, commercial, industrial, construction, and demolition. Determining the amount and type of waste received by an area will become very useful to any production for future decision making. Knowing what the site is receiving will help us take a stand and work in areas we feel are weak in our Sub regions..

d) Waste minimization

Waste minimization is the application of a systematic approach to reducing waste at source. The basic concept is one of preventing the waste generation rather than having to install end-of-pipe treatment systems to solve the problem. Waste minimization is an activity that relates to all inputs and outputs from an industry, business, site or process. Any raw material input to a process that does not become part of the product, is termed waste. This can be in the form of emissions to air, land and water and rejects. Waste is not simply material excess to requirements, but represents a loss in profits and can reflect

as much as between 1% and 4% of a company's turnover. Waste minimization is achieved through the implementation of a number of steps. The first steps include obtaining commitment to the program from senior management, appointing a project champion to manage the program and selecting a project team to assist in data collection. All processes within the factory are then investigated and data collected on all inputs and outputs in terms of quantity and Value.

simple changes you can make to reduce waste in your home.

- Get to know the rules of recycling. ...
- Ditch the plastic bags. ...
- Make a meal plan. ...
- Start relying on reusable containers. ...
- Start composting. ...
- Learn to repair rather than discard. ...
- Cancel unnecessary mail. ...
- Stop using disposable plates.

6.3 Automotive Repair Shops

Automobile repair shops produce many types of waste some hazardous, some not necessarily hazardous but still potentially damaging to the environment if not handled properly, and all requiring proper treatment and/or disposal at significant cost to the business. A list of the types of waste that the shop owner or manager must contend with would include:

- solvents (paints and paint thinners)
- antifreeze
- scrap metal
- batteries and other auto parts
- oils and oil filters
- fuels of various types
- acids and alkalis (contaminated rags and towels)

Whatever the nature and characteristics of the waste may be, it all has one thing in common: All waste represents loss of resources and loss of money.

The most effective way to minimize these losses associated with waste is to avoid producing the waste in the first place. This is the concept behind DNREC's Pollution Prevention Program, which has produced this Fact Sheet to assist you and others in the automobile repair business to reduce your losses while at the same time helping to improve the environment.

Businesses throughout the country have implemented waste reduction programs and found that there are many benefits to be gained from such an approach to the management of resources. Reducing the amount of waste your business generates can help you:

- reduce operating costs
- reduce waste disposal costs
- reduce long-term liability
- help sustain environmental quality
- improve workplace safety and health
- project a positive public image

Getting Started Getting off to a good start is crucial to the success of any endeavor. Here are some important things to consider in undertaking a waste reduction program**:**

- Make a commitment to pollution prevention. This commitment must start at the top, with the owner or manager of the shop, and extend to every employee.
- Involve the employees in designing and implementing pollution prevention measures.
- Provide training in waste reduction techniques and practices. Don't let this be a one-shot effort -- "periodic refresher courses" will help to increase employees awareness of the importance of waste reduction.

- Establish incentives to encourage workers to use waste reduction techniques and to suggest changes, in design or operating procedures that would further reduce waste generation.
- Assess the shop's waste. Identify sources, types, and amounts of waste being produced. This will make it easier to pinpoint areas where waste reduction techniques can be applied and to measure the success of your efforts.

SIDEBAR: Government records indicate that between 1980 and 1986, 98 million automotive batteries, containing 900,000 tons of lead, went unrecovered.

SIDEBAR: About 2.1 tons of used crankcase oil ends up in our rivers and streams every year. A single quart of motor oil can pollute 250,000-gallons of drinking water.

6.4 Establishing Good Housekeeping Practices

Improving a business's housekeeping practices is often the easiest and least expensive way to reduce waste. Good housekeeping includes good inventory control and efficient operating procedures. Here are some housekeeping tips:

- Keep storage and work areas clean and well organized, and keep all containers properly labeled.
- Inspect materials upon delivery, and immediately return unacceptable materials to the supplier.
- Keep accurate records of material usage so that you can measure reductions in use. Mark the purchase date on each container and adopt a "first in, first out" policy so that older materials are used up before new ones are opened; assign someone to distribute and keep track of the materials.
- Locate and repair all leaks to prevent loss of raw materials. Practice preventive maintenance to avoid future losses.
- Keep all containers covered to prevent evaporation and spillage.

- Keep waste streams separate to increase their potential for reuse, recycling, or treatment. Don't allow nonhazardous materials to become contaminated with hazardous materials, as this will result in all of the waste needing to be treated as hazardous waste.Install flow meters, flow control devices, and shut-off nozzles to cut down on water usage.

Self-Check – 6	**Written test**

Name……ID…… Date…….

Directions:

Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Instruction :- Ddiscuses or write the answer for the following questions (20 pts)

1. List at least Five types of waste that the shop owner or manager must contend with would include? (5paint)?
2. List at least two housekeeping tips? (5 poin)t
3. Define Waste management and disposal(3pts)
4. List out Waste management techniques(7pts)

Note: **Satisfactory rating >=10 points Unsatisfactory <10 points**

Score = _____
Rating: _____

Information Sheet 7-Identifying procedures for maximizing energy efficiency

7.1. maximizing energy efficiency

Wondering where or how to get started in making your workplace **more energy efficient and sustainable**? Here are a few simple ways you can save energy in the workplace and bring positive changes to your working environment:

1. Switch off artificial lights and use natural light

Artificial lights consume power – **natural light is free**. So, limit the use of artificial lighting to the dark areas in the workplace that are out of the sun's reach.

If not in use, switch off the lights at meeting rooms, pantry, reception, corridors, or stairs. If there's nobody in the room for more than a couple of seconds – **kill the lights**!

2. Choose energy efficient light bulbs

Less energy spent means less money wasted on electricity bills. If your workplace does not get enough natural light during the daytime, you can opt for **low wattage lights**.

You can also replace existing bulbs with CFL or LED lights. They consume less power and last for longer periods of time.

3. Choose laptops over desktops

Laptops typically consume less energy compared to desktops, so keep this in mind when buying your workplace equipment. Opt for laptops whenever possible.

The **monitor size** also contributes to the amount of energy consumed. While graphic designers and people from similar lines of work cannot work on small screens, there are a lot of other employees in your company whose work doesn't depend on the huge monitors.

Make the right selection and keep the screen size at a reasonable level when it comes to monitor choice. Smaller monitors spend less.

4. Use hibernation feature on all computers

Advise everyone to put their computers in hibernation mode if they take a break or go to a meeting. This applies to any situation when an employee won't be using it for a long period of time.

The hibernation feature in computers allows users to save existing work as it is and continue working at the exact same point upon return. Employees can set their computers to go into the hibernation mode when they are inactive for several minutes.

5. Use energy saving features of all devices

Make sure that your employees are aware of the **energy-saving features** of appliances and other electronics like the printers, microwaves, and air conditioners. Most of the modern devices have these options and they are usually very easy to use. In most cases, it is a matter of pressing a button or adjusting a setting feature. Advise everyone to use these features to **help cut energy costs.**

6. Upgrade all outdated equipment

Old electrical equipment that is no longer working at their maximum efficiency could only **draw unnecessary power**, costing you more money. It's best to replace your old office appliances with new certified energy efficient ones.

However, make sure that you **dispose of your old equipment in a proper way** and recycle it. There are a lot of companies that specialize in recycling this type of waste. You just need to find a company that recycles electronic waste near you and call them.

7. Buy energy efficient devices

Energy efficient devices may cost more upfront but they're going to consume less, saving you more money in the long run. Their price is decreasing, because, nowadays, being **energy efficient is becoming a standard** that a lot of companies try to keep.

The secret to getting the most out of your energy efficient devices in the workplace is keeping them properly maintained to avoid having to keep buying new ones.

8. Do an energy audit

It's good to check your workplace's energy consumption and **evaluate your overall energy efficiency** by doing energy audits. This way, you'll know whether you are consuming way too much energy or using just enough to sustain the business operations. This is also one way to see if your energy saving efforts are working and paying off. There are energy audit companies you can hire and they can help you identify areas where you can trim down your energy consumption.

9. Switch off equipment when not in use

Just like with lights, make sure that you switch off and plug out all equipment when not in use. This includes air conditioners, coffee vending machines, hand dryers, microwaves, printers, copiers, and scanners during weekends or holidays.

These electrical devices continue to drain power even if they are plugged in. This is sometimes called standby energy consumption or vampire energy drain. This type of energy consumption adds hundreds of millions of dollars to annual electricity bills all over Australia.

Making sure all of your devices are plugged out after working hours as this saves energy and reduces your electricity bill.

10. Print only when necessary

Avoid printing files that can be sent via email. There are many ways you can **share** or **store** important files today.

Modern technology gives you a ton of options, including cloud storage, email clients and even ped drives if you insist.

Aside from **reducing paper wastage**, this also helps **cut the total amount of energy consumed** by the printer.

11. Control your heating and cooling

Cutting down on air conditioning could mean significant savings for you. Don't make drastic difference between the temperature outside and the one in your workplace, but keep in mind the conditions of optimum working environment.

12. Promote sustainability in the workplace

Promote sustainability throughout the company. Explain to you employees why it's important and in what ways everyone can benefit from it.

You can start small by sending out a **reminder** for everyone to always check if their computers are unplugged before leaving the office at the end of their shifts.

The secret to reducing energy consumption in the workplace is **getting your employees on board**, making small changes in their daily habits at work.

If you think about it, improving a business' profitability can be as simple as **being wise** with everything you spend money on, like **energy**.

Saving energy in the office doesn't only reduce your electricity bills, but contributes a lot to the environment by lessening carbon pollution, making your workplace worthy of a Green Star.

Moreover, going green definitely **improves your reputation** and has amazing positive effects on your company's image and brand.

Self-Check -7	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction :- Ddiscuses or write the answer for the following questions (10 pts)

1. List at least four ways you can save energy in the workplace and bring positive changes to your working environment (10 ponit)

Note: **Satisfactory rating >= 5 points** **Unsatisfactory < 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation sheet 1

OPERATION TITLE:- Steps of Job Specification

PURPOSE:- To create a rough outline of your job description before setting down to write the final versions.

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

properly sorted working area

Properly operated tools and equipments

Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

Hand tools steel rule etc.

Equipments

Material-A3,A4 paper,etc.

PROCEDURE:-

Step 1 Decide on the job title. ...

Step 2 Include the details of the job. ...

Step 3 Create a summary of the job. ...

Step 4 Include the duties and responsibilities of the job. ...

Step 5 Add job factors to the description

Step 6 Write up a rough outline

PRECAUTIONS:-

Wear working cloths which properly fit with your body

Make working area hazard free

Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA: Assured performing of the activities correctly accordance with the given procedure mentioned above.

LAP TEST	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 6 hour. The project is expected from each student to do it.

Task1 : Prepare /create a rough outline of your job due to Job Specification.

LG #28	**LO #2- Perform tungsten inert gas (TIG), MIG and spot welding procedures**

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Accessing Information to enable welding in accordance with vehicle *tool and equipment* manufacturer procedures.
- Carrying out TIG, MIG/MAG and *spot welding*
- Completing *Gas tungsten arc (TIG), MIG/MAG* and spot welding procedures without causing damage.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Acceses Information to enable welding in accordance with vehicle *tool and equipment* manufacturer procedures.
- Carry out TIG, MIG/MAG and *spot welding* according to a standard that meets

industry regulations/guidelines, OHS requirements, legislation and enterprise policy/procedures.

- Complete *Gas tungsten arc (TIG), MIG/MAG* and spot welding procedures without causing damage.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Accessing Information to enable welding in accordance with vehicle *tool and equipment* manufacturer procedures

1.1. MIG/MA,TIG and Spot WELDING TOOLS AND EQUIPMENTS

Equipment for **MIG/MA,TIG and Spot** welding are used. In addition to tools and some consumables are also used in **MIG/MA,TIG and Spot** welding.

1.2. Component manufacture specifications

Component manufacturing references the individual manufacturing services utilized to produce individual components of a system. Component manufacturing refers to metal and plastic manufacturing services including simple weldments, manifolds and tube assemblies. Some manufacturing service providers are able to manufacture components with metals and plastics, and many can also build products to meet specifications.

The Manufacturing Specification is an alternative to producing separate sheets for the manufacturing flow chart, sequence drawing and final 3D drawing.

It is a concise sheet, which summaries each of these design sheets. When creating this sheet, check everything you write and draw against the specification you wrote earlier in the project, after the research section.

A manufacturing specification contains all the information that is needed to make the product.

It describes the stages of manufacture and the materials needed, using flowcharts, diagrams, notes and samples. A manufacturing specification is done once the final product has been developed

1.3. Manufacturer specifications and operational procedures

The written specifications, instructions or recommendations provided by the manufacturer of equipment or supplies that describe how the equipment or supplies are to be

constructed, erected, installed, assembled, examined, inspected, started, operated, used, handled, stored, stopped, calibrated, adjusted, maintained, repaired or dismantled,
an instruction, maintenance or operating manual provided by the manufacturer of equipment or supplies; (directives du fabricant)
written guide lines established by a manufacturer for the installation and operation of the manufacturer's equipment.
Standard operating procedures (SOPs) are written instructions intended to document how to perform a routine activity. Many companies rely on standard operating procedures to help ensure consistency and quality in their products.
A standard operating procedure (SOP) is a set of step-by-step instructions compiled by an organization to help workers carry out complex routine operations. SOPs aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations.

1.4. Customer requirements

A customer requirement is a specification that originates with customers as opposed to internal stakeholders. This can include both functional and non functional requirements for products, services and experiences.
There can be two types of customer requirements:

i. **Service Requirement**: Intangible aspects of purchasing a product that a customer expects to be fulfilled. It consists of elements like on-time delivery, service with a smile, easy-payment etc. It encompasses all aspects of how a customer expects to be treated while purchasing a product and how smooth his buying process goes.
ii. **Output Requirements**: These are mostly the tangible characteristics, features or specifications that a consumer expects to be fulfilled in the product. If a consumer is availing a service as a product, then various service requirements can take the form of output requirements. For example, if the consumer is hailing a metro cab, then on-time arrival becomes an output requirement. For other products such as gadgets, the product specifications like the loudness and clarity of a pair of speakers becomes its output requirements.

1.5. Industry/workplace codes of practice

The purpose of an industry code is to ensure industry compliance with an agreed upon set of objectives that benefit workers, employers and consumers. These objectives usually concern the promotion of best industry practice, improving safety standards and enhancing consumer confidence.

A code of practice provides practical guidance for people who have work health and safety duties. These codes give guidance on:

How to achieve the standards required under the Act

Effective ways to identify and manage risks.

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the Act, in relation to the subject matter of the code.

Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

1.5.1. Benefits of an industry code of practice

An industry code of practice provides a range of benefits to both industry and consumers such as:

The creation and enforcement of appropriate industry practices formulated by industry experts.

The flexibility of an industry code allows businesses to respond to recurring market issues and adapt to changing consumer needs.

A business-friendly alternative to legislation that can result in reduced costs for industry and government.

Providing safeguards and protection for consumers.

An industry code of practice will set out a framework for compliance through provisions such as:

Specific measures for compliance, relevant guidelines, standards and practices;

Risk management strategies;

Complaint handling schemes and sanctions for non-compliance; and

An outlined process for periodic review of the code.

1.6. Material safety data sheets

A Material Safety Data Sheet (MSDS) is a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product. It is an essential starting point for the development of a complete health and safety program. It also contains information on the use, storage, handling and emergency procedures all related to the hazards of the material. The MSDS contains much more information about the material than the label. MSDSs are prepared by the supplier or manufacturer of the material. It is intended to tell what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if accidents occur, how to recognize symptoms of overexposure, and what to do if such incidents occur.

There are nine (9) categories of information that must be present on an MSDS in Canada. These categories are specified in the Controlled Products Regulations and include:

Product Information: product identifier (name), manufacturer and suppliers names, addresses, and emergency phone numbers,Hazardous Ingredients

Physical Data,Fire or Explosion Hazard Data

Reactivity Data: information on the chemical instability of a product and the substances it may react with Toxicological Properties: health effects,Preventive Measures and First Aid Measures

Preparation Information: who is responsible for preparation and date of preparation of MSDS

1.7. Workplace procedures relating to reporting and communication

Workplace procedures communicates an organisation's values and the organisation's expectations of employee behaviours and performance. Workplace policies often reinforce and clarify standard operating procedure in a workplace. Many routine matters can be dealt with through simple workplace procedures and processes being put in place.

Employers often provide employees with handbooks, policies and procedures which regulate workplace matters such as:

- Work health and safety.
- Anti-discrimination and equal employment opportunity.
- Occupational Health and Safety.
- Use of company property.
- Use of social media.
- Drug and alcohol use.
- Employee performance management and discipline.

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction I: **- chose and write the letter of the correct answer on the space provided or on the separate answer sheet (6 pts)**

1.---------- is a document that contains information on the potential hazards.(6)

A. Manufacturing Specification B. Customer requirements

C. workplace codes of practice

Instruction ii :- **give short answer for the following questions(4pts**)

1. Write types of customer requirements(4pts)

Note: **Satisfactory rating >=5 points Unsatisfactory - below <5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 2- Carrying out TIG, MIG/MAG and *spot welding* according to a standard that meets industry regulations/guidelines, OHS requirements, legislation and enterprise policy/procedures

2.1 TIG and MIG/MAG welding

Tungsten inert gas (TIG) welding, another form of GMAW, uses a nozzle-fed shielding gas and a hand-held filler rod. It has somewhat limited use in body shop repair applications. In a general auto repair or engine rebuilding, how- ever, it does things that make it a valuable tool.MIG welders lay down weld beads at the average of 25 inches (635 mm) per minute. TIG welding is much slower, with weld speeds ranging between 5 and 10 inches (127 to 254 mm) per minute. However, this slower speed allows for much more control, and the end result is the best-looking weld obtainable. A TIG unit can be used to re- pair cracks in aluminum cylinder heads and reconstruct combustion chambers and other automotive components that need to be welded.

Like MIG (Figure 5), TIG welders use an inert gas, such as argon or helium, to surround the weld area and pre-vent oxygen and nitrogen in the atmosphere from contam-inating the weld. But instead of having a wire feed welding electrode like MIG units, TIG machines use a tungsten electrode with a very high melting point (about 6,900°F) to strike an arc between the welding gun and the work.

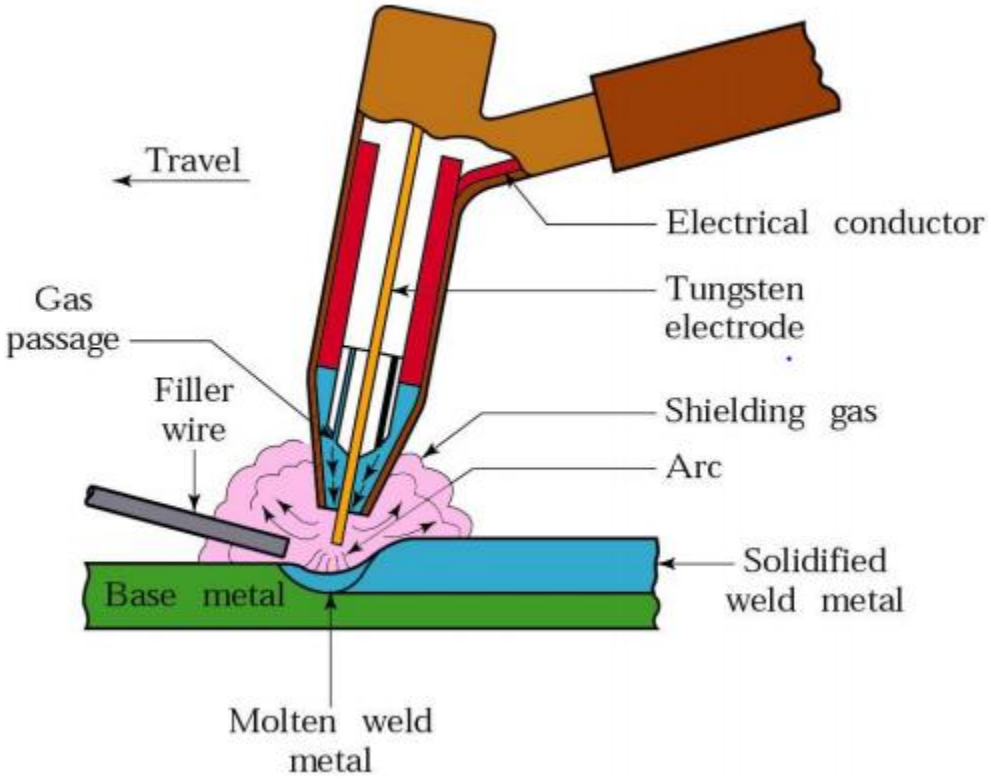


Figure 5 principles of TIG welding procese

Because the tungsten electrode has such a high melt- ing point, it is not consumed during the welding process.A filler rod must be used for welding thicker materials (Figure 6).

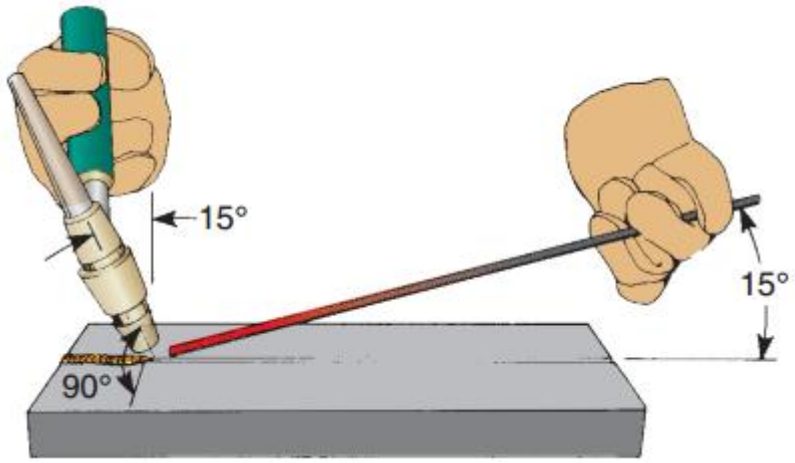


Figure 6 proper position of torch in TIG welding

Fig proper position of the torch and filler rod for manual TIG welding.

2.2.Principles Of Mig Welding

The welding method uses a welding wire that is fed automatically at a constant speed as an electrode. It has a DC electrical source (an electrical power supply). A short arc is generated between the base metal & the wire and the resulting heat from the arc melts the welding wire & joins the base metals together. MIG welders lay down weld beads at the average of 25 inches (635 mm) per minute. During the welding process either inert or active gas shields the weld from the atmospheric & prevents oxidation of the base metal.

Table 5 type of inert or active gas used depends on the base material to be welded.

Base material	Shield gas
Steel	Carbon dioxide (Co_2)
Aluminum	Argon (mixture of Argon & Helium)
Stainless steel	Argon with a little oxygen (b/n 4&5%)

MIG welding uses the short circuit arc method that is a unique method of depositing molten drops of metal on to the base metal.

The short circuit arc method uses very thin welding rods a low current & voltage.

By using this technique the amount of heat introduced in to the panels is kept to a minimum & penetration of the base metal is quite shallow.

MIG: become popular in body repair work after the car manufacturers began using thin gauge high strength low alloy steels (HSLA)

MIG welding provided clean fast welds all applications.

Example:-Welding a rear quarter panel with an oxyacetylene welder averages about 4 hours. A MIG welder can do the same job in about 40 minutes.

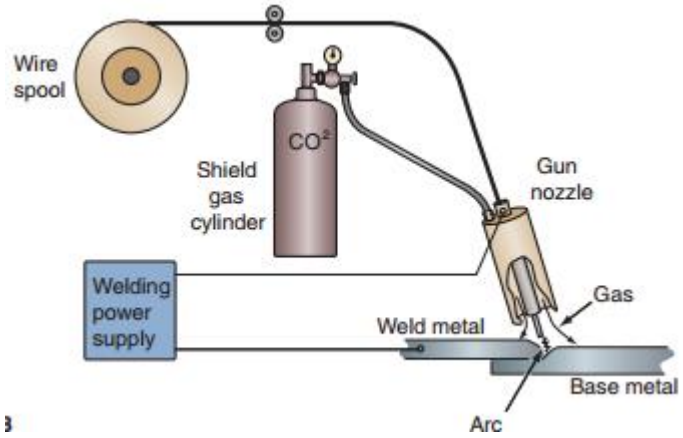


Figure 7 principles of MIG welding

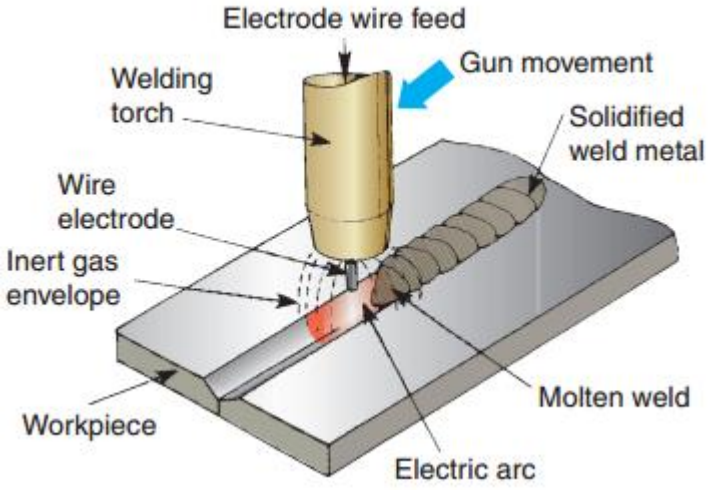


Figure 8 basic MIG welding component

Fig basic MIG welding component

2.2.1. The advantages of MIG welding

- Easy to learn to use.
- It provides 100% fusion in the parent metals.
- Low current can be used for thin metal.
- The arc is smooth/ the weld peddle small, it is easy to control).
- Big gaps of two joint can be welded by filling the gap.
- All steel can be welded with one common type of weld wire.
- It is easy to control the temperature & time.
- In this welding process the small area to be welded is heated for a short period of time.

2.2.2. MIG WELDING EQUIPMENT

Regardless of the type of MIG equipment used, it will comprise the following basic components.

- Supply of shielding gas with a flow regulator to protect the molten weld pool from contamination.
- Wire/feed control to feed the wire at the required speed.
- Spool of electrode wire of a specified type & diameter.

- Welding machine connected to an electrical power supply.
- Work cable & clamp assembly.
- The shield gas most commonly used for collision repair welding is carbon dioxide.
- mixture of Argon & carbon dioxide (C-25 gas) it mean 75% Carbon dioxide & 25% argon.
- Welding gun & cable assembly that the welder holds to direct the wire to the weld area.

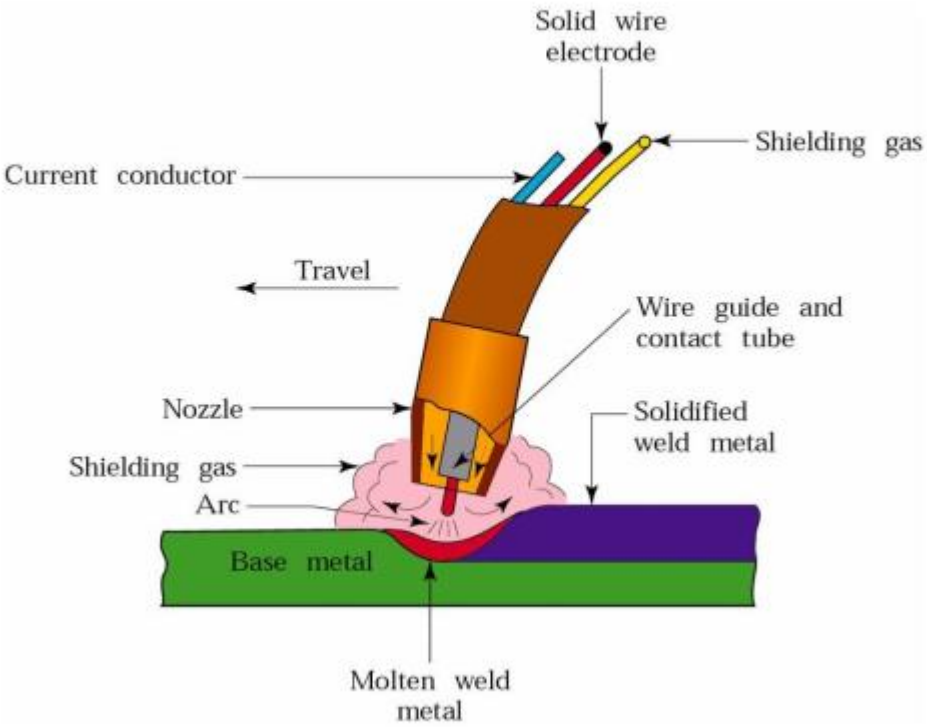


Figure 9 MIG/MAG welding

2.2.3. MIG/MAG,TIG ProcessCharacteristics

The heat source used to melt the parent metal is obtained from an electric arc that is formed between the end of a consumable electrode wire and the work piece. The arc melts the end of the electrode wire, which is transferred to the molten weld pool. The

electrode wire is fed from a spool that is attached to the wire driving system and passes through a set of rolls, which are driven by a variable speed electric motor. By varying the speed of the motor, the level of the welding current can be adjusted - high wire feed speed gives high welding current. Altering the voltage can also vary the arc length - high voltagesgivelongerarclengthsandviceversa.

In order to prevent the air reacting chemically with the molten metal, a shielding gas of either CO2 or argon/CO2 mixture is passed over the weld zone from a nozzle attached to the welding gun or torch. This protects the molten droplets passing across the arc and the moltenweldpool.

Electrical power for the process is a direct current that is obtained from a transformer-rectifier. The welding gun or torch is connected to the positive pole of the power supply unit and electrical contact to the wire is obtained as close to the arc as possible by means of a copper contact tip or tube.

The metal at the end of the electrode is melted and transferred to the molten weld pool. The two main types of transfer are:

i. Spray or globular transfer.
ii. Short-circuiting or dip transfer.

2.2.4. Spray Transfer/Globular Transfer

This type of metal transfer generally occurs at high current and high arc voltage ranges,

e.g., 250 - 600 Amps at 28 - 40 volts. As the current is increased the rate at which the droplets are transferred across the arc increases and they become smaller in volume. The droplets can be seen in a high-speed cine film but cannot be seen with the naked eye. It appears as if there is a spray of metal.

The type of shielding gas greatly affects the current rate at which the spray transfer occurs. The use of CO2 as a shielding gas requires a much greater current density than argon to produce the same droplet rate.

With the use of high currents giving strong magnetic fields very directional arcs are produced. In argon shielding gases the action of these forces on the droplets is well balanced and transfer from wire to work is smooth with little or no spatter. However, with a CO2 shield the forces tend to be out of balance giving rise to an arcing condition that is less smooth and spatter levels are heavier. Metal transfer under these conditions is normally called globular or free flight.

The welding conditions that give spray or globular transfer are normally associated with high deposition rates on medium and thick sections giving high productivity. It has a higher heat input and can only be used in the flat and HV positions except when welding aluminum when it can be used in all positions.

2.2.5. Short Circuiting Arc/Dip Transfer

When using lower arc voltages and currents, generally in the 16 - 26 volt and 60 - 180 ampere ranges, metal transfer takes place during short circuits between the electrode and the weld pool, giving a lower heat input. These follow a consistent sequence of alternate arcing and short circuiting causing the end of the electrode wire to dip into the weld. As the wire touches the weld pool there is a rise of current, the resistance of the wire causes heating and the end of the electrode melts. The wire necks due to a magnetic pinch effect and the molten metal flows into the pool. During this short circuit period the current delivered by the power source is much higher than during arcing - typically 1000 - 1500 amps. This creates high forces that have an explosive effect on the weld pool and spatter is considerable. To reduce this effect an inductance is connected in series with the power supply and the arc to reduce the rate of rise of current during the short circuit period. The short circuit is cleared more slowly and gently, and the spatter is reduced to an acceptable level. Ideally the droplets are transferred in an almost irregular dip/arc cycle taking place about 50 - 200 times a second. Too little inductance gives rise to unstable arcing conditions, excessive spatter and lack of fusion defects.

The dip transfer mode is used for the welding of thin sheet and medium plate, and for all thicknesses when welding in the vertical or overhead positions. (With thicker plate there can be lack of fusion problems.)

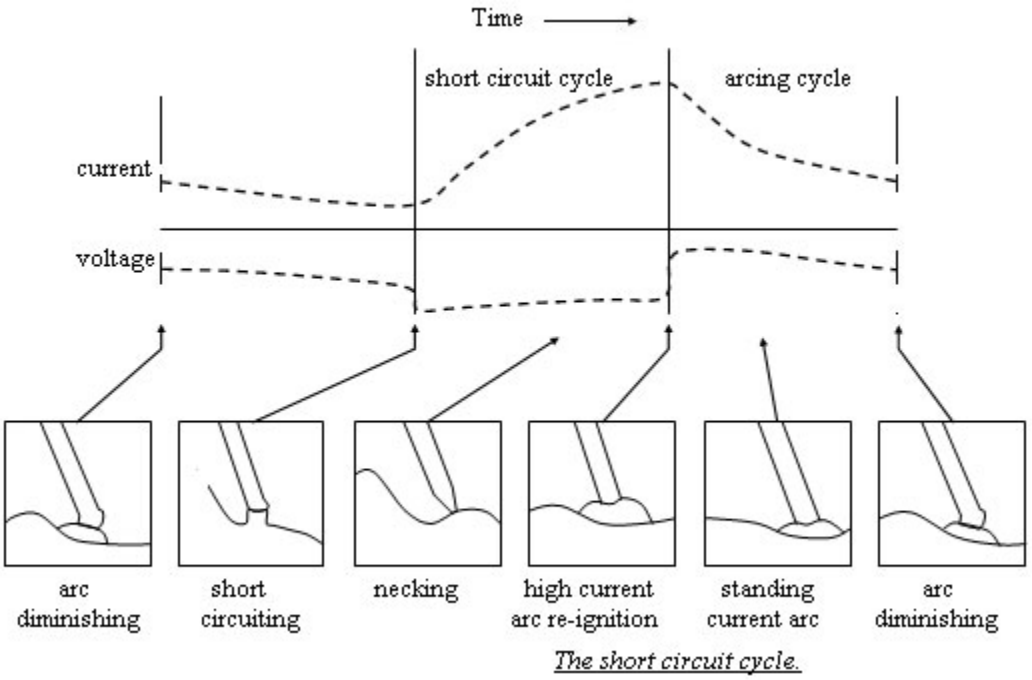


Figure 10 short circuit cycle

Mixed Arc Transfer:-his is a globular transfer using medium volts and medium amperes. It is generally unusable having an unstable arc and high spatter levels. Use is mainly with flux cored wires in filling passes.

Pulsed Arc Transfer:-this is a synergic transfer of 50 - 250 kilohertz that combines short circuit and spray transfers. It uses high and low voltages and amperages, and can be used in all welding positions on plate thicknesses greater than 6 millimeters.

2.2.6. Welding Variables and Parameters

1. Electrode extension - affects the amperage. Stick out length should be 10 - 15 mm.
2. Inductance - ' smoothes' the arc characteristic. Also called the choke. Set low gives excess penetration and high, no penetration.
3. Wire feed speed - amperage. Controls fusion and penetration.
4. Travel speed - controls depth of penetration.
5. Gas flow rate - protects weld from atmosphere.
6. Voltage - set on the welding machine and controls the arc length.
7. Tilt angle -back or fore hand should be not greater than 15° from the perpendicularThe welding position and type of weld are further variables to be considered

Sets are manufactured in a range of sizes, identified by current, similar to metal arc welding. Currents below 200 A can only give dip transfer operation, suitable for welding steel only.
Larger sets may have the wire reel and motor as a separate unit, so it can be placed near the job. Controls on the set adjust output voltage and may allow a choice of inductance. The wire speed control will be on the wire feed unit.
Electrical input is from single phase 240 V mains for small sets, or three phase 415 V for medium size and upwards. Output is always DC with a flat output characteristic for semi automatic and drooping output for mechanized.

Sets which supply current in pulses (at 40 - 200 per second) give improved results on some jobs. Because the 'pulse-MIG' increases the number of controls, an electronic 'synergic' control system varies all the parameters in step to simplify adjustments. Sets often have a built-in holder for a gas cylinder.

A set will usually be supplied with a suitable welding gun. Heavy duty guns may be water cooled and the set may have a water tank and cooling radiator built in.

When welding aluminum the wire is soft and tends to kink when pushed through a hose. A gun carrying a small reel of wire - 'reel-on-gun', obviates this.

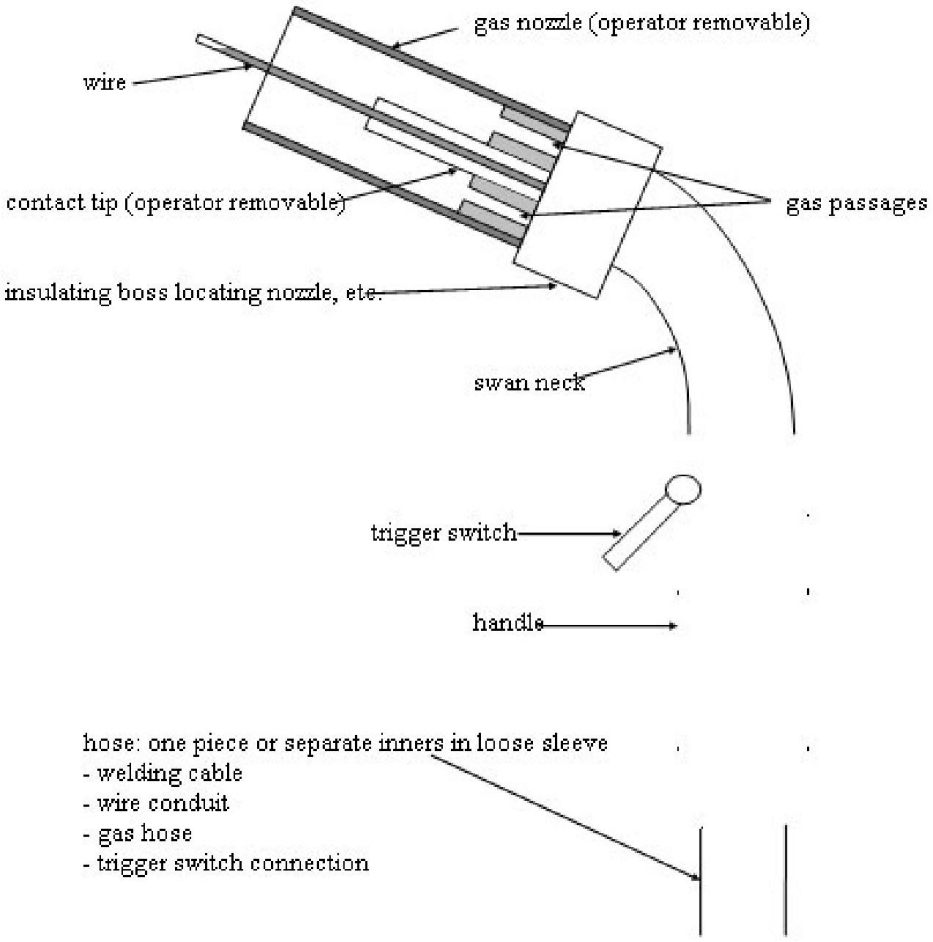


Figure 11 MIG welding gun

i. Accessories

Welding cables
Connectors to set. } Similar to manual metal arc - one set usually included.

ii. **Clamps or clips**.

Gun and connecting hose assembly to suit current, usually supplied with set.

Gas regulators and hose, connections to suit.

Vaporizers for carbon dioxide gas on industrial sets.

Cylinder stand

iii. **Spares**

The following parts come into contact with the wire - spares are needed to replace worn parts, or if wire size or type is changed.

Inlet and outlet guides

Drive rolls. } On drive assembly.

- Contact tip in gun - needs fairly frequent replacement.
- Gas shielding nozzle for gun - various sizes to suit different jobs.
- Wire conduit liner - spring steel coil (like curtain wire) for steel electrode wire, or plastic tube for aluminum.

2.2.7. Typical Defects and Causes

a.Lack of fusion

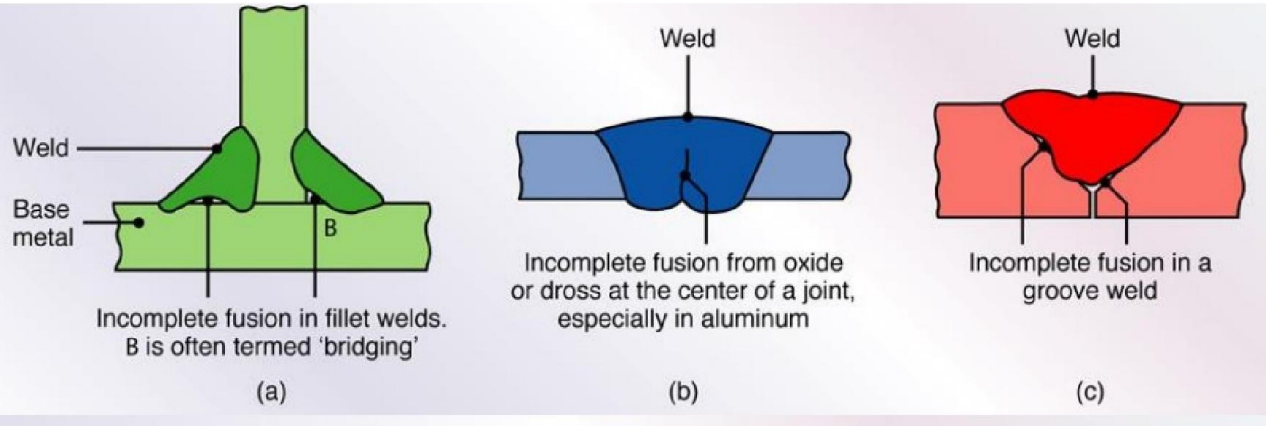


Figure 12 lack of fusion

b.Excessive/lack of penetration

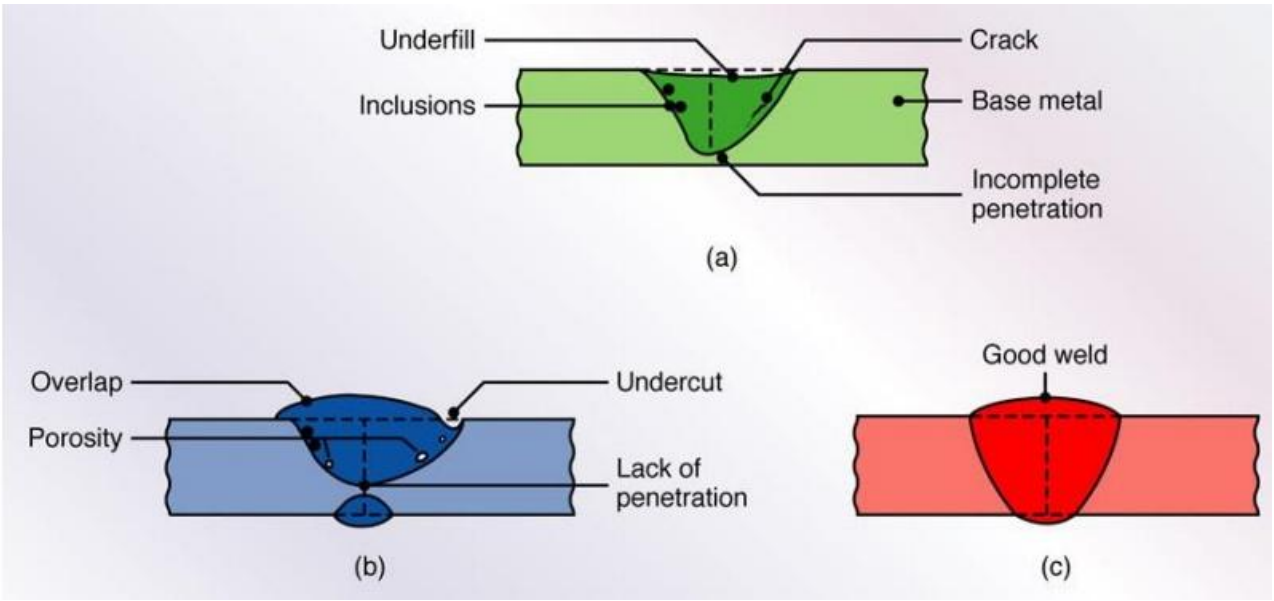
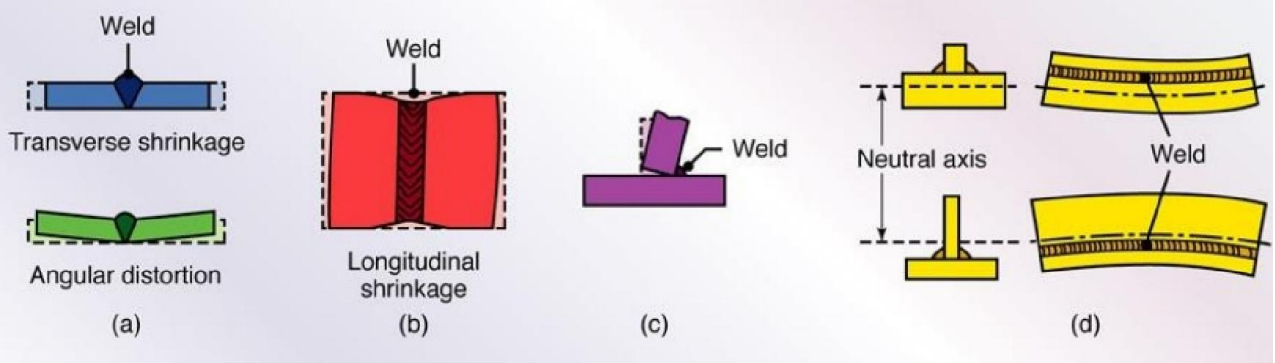


Figure 13 Excessive/lack of penetration

c.Silica inclusions (with steel only).



d.Solidification (centerline) cracking

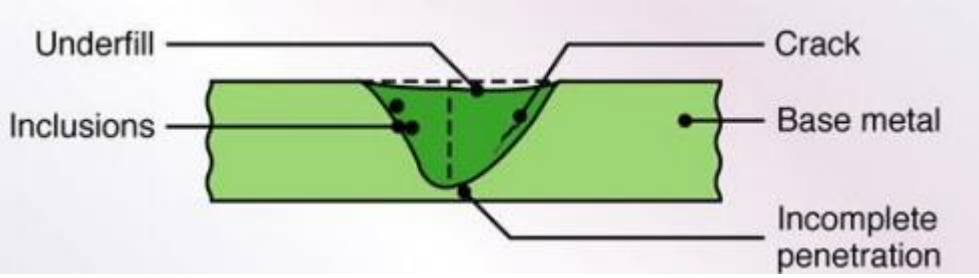
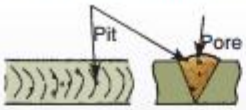
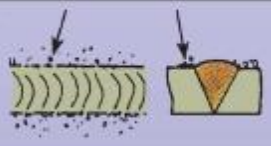
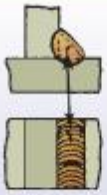
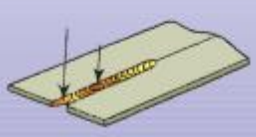


Figure 14 center line crackin

Table 6 welding prequtions

Defect	Defect Condition	Remarks	Main Causes
Pores/pits		There is a hole made when gas is trapped in the weld metal.	1. There is rust or dirt on the base metal. 2. There is rust or moisture adhering to the wire. 3. Improper shielding action; the nozzle is blocked or wind or the gas flow volume is low. 4. Weld is cooling off too fast. 5. Arc length is too long. 6. Wrong wire is selected. 7. Gas is sealed improperly. 8. Weld joint surface is not clean.
Undercut		Undercut is a condition where the overmelted base metal has made grooves or an indentation. The base metal's section is made smaller and, therefore, the weld zone's strength is severely lessened.	1. Arc length is too long. 2. Gun angle is improper. 3. Welding speed is too fast. 4. Current is too large. 5. Torch feed is too fast. 6. Torch angle is tilted.
Improper fusion		This is an unfused condition between weld metal and base metal or between deposited metals.	1. Check torch feed operation. 2. Is voltage lowered? 3. Weld area is not clean.

Overlap		Overlap is apt to occur in a fillet weld rather than in a butt weld. Overlap causes stress concentration and results in premature corrosion.	1. Welding speed is too slow. 2. Arc length is too short. 3. Torch feed is too slow. 4. Current is too low.
Insufficient penetration		This is a condition in which there is insufficient deposition made under the panel.	1. Welding current is too low. 2. Arch length is too long. 3. The end of the wire is not aligned with the butted portion of the panels. 4. Groove face is too small.
Excess weld spatter		Excess weld spatter occurs as speckles and bumps along either side of the weld bead.	1. Arc length is too long. 2. There is rust on the base metal. 3. Gun angle is too severe.
Spatter (short throat)		Spatter is prone to occur in fillet welds.	1. Current is too great. 2. Wrong wire is selected.
Vertical crack		Cracks usually occur on the top surface only.	1 There are stains on the welded surface (paint, oil, rust).
Nonuniform bead		This is a condition in which the weld bead is misshapen and uneven rather than streamlined and even.	1. The contact tip hole is worn or deformed and the wire is oscillating as it comes out of the tip. 2. The gun is not steady during welding.
Burn-through		Burn-through is the condition of holes in the weld bead.	1. The welding current is too high. 2. The gap between the metal is too wide. 3. The speed of the gun is too slow. 4. The tip-to-base metal distance is too short.

i. **Porosity**

Gas flow too high or too low , Blocked nozzle,Leaking gas line, Draughty conditions,Nozzle to work ,distance too long.Painted, primed, wet or oily work

surface,Damp or rusty wire

ii. Lack of penetration

Current too low, Prep to narrow,Root face too thick, Root gap too small,Worn tip causing irregular arcing,rregular wire feed,Poor technique,Mismatched joint.

iii. Undercut

Speed too high,Current too high,Irregular surface, Wrong torch angle.

iv. **Spatter.**

Inadequate choke,Voltage too low,Rusty or primed plate,Crater cracking, Poor finishing technique.

2.2.8. types of welding joints

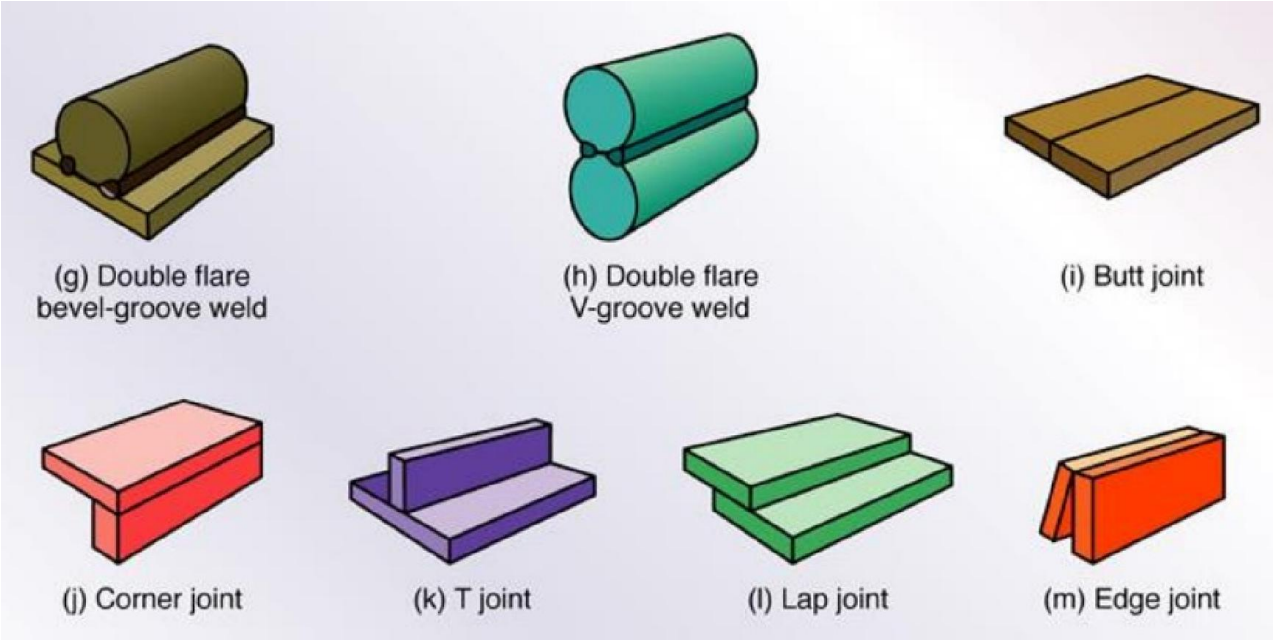


Figure 15 tyjpes of welding joint

2.2.9. Welding Position

In collision repair the welding position is usually indicated by the location of the weld in the structure are

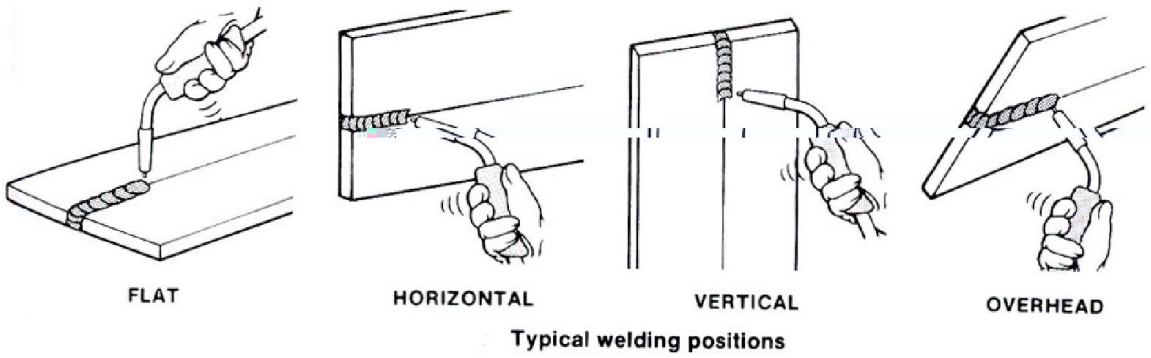


Figure 16 typical welding position

Note:-POSITIONAL WELDING is best performed by dip transfer method since the lower arc energy enables the molten metal to solidify more quickly after deposition. Vertical welds in thin sections are usually made downwards with no weave. Thicker sections are weld upwards, weaving as required. Overhead welding, which is performed only when absolutely necessary, is performed with no weave.

2.2.10. Welding techniques

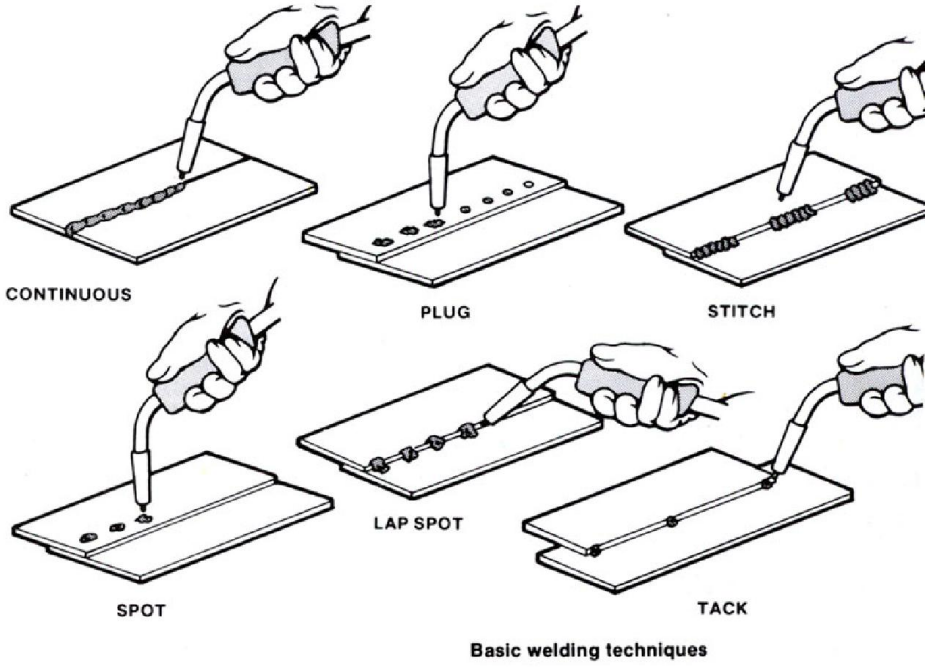


Figure 17 basic welding position

i. Tack weld

It is a temperature welding method to keep the alignment (like clamp or sheet metal screw)

The distance between each tack welding is determined by the length & thickness of a panel

ii. Continuous Welding

In this method by keeping proper tip-base metal distance & correct gun angle welding up to the end of the panel

iii. Plug Weld

To do this weld first a hole is drilled through the outside piece (pieces), then the arc is directed through the hole to penetrate the inside piece & hole is filled with molten metal.

iv. Spot Weld

Example:-In a MIG weld the arc is directed through the hole to penetrate both pieces of metal while triggering a timed impulse wire feed.

v. Stitch Weld

It is similar to continuous weld but not the whole work pieces, rather there is an interruption

Note:-As a general rule dip transfer is used for thinner sections up to 6.4 mm and for positional welding, whilst spray transfer is used for thicker sections.

The gun is held at an angle of 80^{o} or slightly less to the line of the weld to obtain a good view of the weld pool, and welding proceeds with the nozzle held 6-12 mm from the work. Except under special conditions welding takes place from right to left. If welding takes place for special reasons from left to right the torch has to be held almost 90^{0} to the line of travel and care must be taken that the gas shield is covering the work.

2.3.Principle of spot welding

Spot welds are formed when a large amount of current is passed through the panels for the correct amount of time and with the correct amount of pressure. In a typical spot welding application there are two electrodes, opposite each other, which squeeze the metal pieces together. This squeezing pressure is controlled.

The pieces to be welded are heated by passing welding current through them. Several thousand amperes of welding current are applied for a specified period of time. As the temperature is elevated, the metal is heated to a plastic state. The force of the welding tip will deform the metal and form a small dent as the metal gets hot. As the heat builds in the metal, a small liquid pool of metal is formed at the interface. This pool is typically the same size as the face of the welding tip. When welding temperature is reached, the timer should expire. The weld zone cools very quickly because the copper welding tips pull heat out of the weld zone. Heat also escapes as it flows into the surrounding metal. The TITE-SPOT Welding Pliers should be held closed for at least one second to cool the weld.
WARNING: Care must be taken with an air closed apparatus that instantly releases after the weld is formed.

In short Resistance Spot Welding (RSW)

- A high amperage electric current passes through the metal.
- Resistance to the electrical current flow heats the metal to welding temperature.
- The process is used to weld together two or more overlapping pieces.
- The process is well suited for automatic welding.
- The weld is made between two electrodes (made of copper alloys) which press the metals together.
- The process is controlled by the amperage, the electrode pressure, and the timing.
- High welding rate (very cost effective).
- Thickness of welded sheets is limited (about 6 mm).

There are 4 variables to consider with spot welding;*Pressure ,Weld Tim, Current and Tip Diameter*

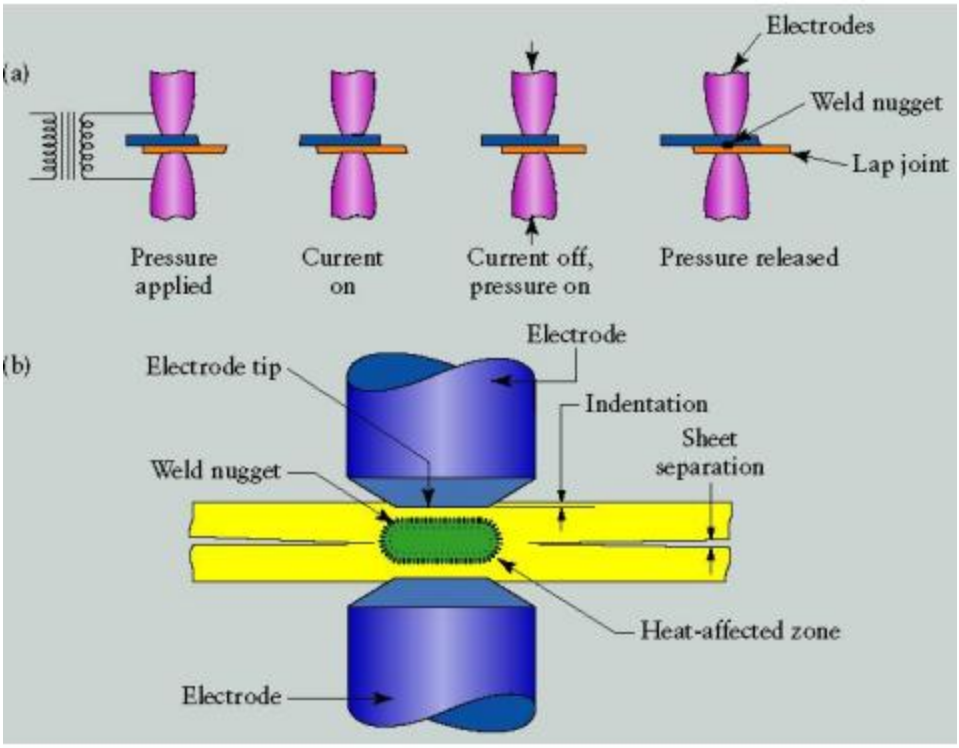


Figure 18 spot welding form

Pressure: the amount of pressure that is applied to the weld is important.

If too little pressure is applied, the joining area will be small and weak. If too much pressure is applied, then cracking can occur in the weld because of the quenching effect of the welding tips. Also, high pressure can cause thinning of the metal and cause a weakness. The depth of depression on the sheet surfaces caused by welding electrodes should never exceed 25 percent of the sheet metal thickness.

Typically a body shop welds steel between 16 gauges and 24 gauges. If a spot welder has adjustable length tongs, a pressure gauge should be used to properly set the pressure. The pressure is important and should not be guessed at. On the sheet surfaces caused by welding electrodes should never exceed 25 percent of the sheet metal thickness.

Three types of spot welding timers:

1. **standard weld timer** controls the amount of time the current flows into the welding transformer. The inherent problem is that if welding is not taking place the timer is still ticking. Therefore, if welding current is only flowing for part of the cycle, a weld may not be formed before the timer runs out. What generally happens is, the technician increases the length of time the timer will run. This can cause overheating of the welding tools and transformer! Double cycling on the weld zone is also a technique which is used, but it also causes overheating.
2. **Manual control**: Sometimes the timer is bypassed by the operator and he times the welds manually. Good welds can be produced in 1/2 to 1 3/4 seconds this way. This probably puts less thermal stress on the welding tools and transformer than the "standard weld timer".
3. **Adigital timer control**:- verifies welding is taking place. This type of timer checks all cycles of a 60 cycle second and will not increment the timer unless welding current is flowing! The Digital timer has a precise interface for selecting and adjusting the power and timer settings. The digital control that verifies welding puts the least amount of thermal stress on the welding tools and transformer.

Weld current and weld time are inversely proportional. Welding current and time are used to bring the metal to welding temperature (2550 Degree F.).

Weld Temperature = i^2 x t x R.

Welding current in a body shop environment has a range of 3000 to 5000 amperes. Welding current (i) and weld time (t) are to be controlled by the technician but Resistance (R) is determined by the gauge of the parts being welded. Since welding current is squared, changes in weld current are much more dramatic than changes in weld time.

Welding current settings are very important when welding today's vehicles. If weld current is at the low end of the range, weld time must be increased.

NOTE 1: Using low current on the welds can cause overheating of the welding tools and the welder's transformer.) Conversely, if weld current is high then weld time is decreased.
NOTE 2: Using high weld current increases the problem of expulsion. Expulsion is molten metal squirting from between the layers of steel. The galvanized coatings found on today's automotive steel aggravate the problem of expulsion.) So we can see, welders that do not control weld current will be more difficult to use.

There are two types of weld current controls, **Analog: uses** a knob and it is set like a radio knob. **Digital: uses** a LED display that tells the technician the exact power setting. The usual interface is a push button.

The digital interface is so precise that the operator can set the machine easily. Very small changes in power or time can be made quickly to make perfect welds while eliminating expulsion. Timer verification is letting the timer "tick" only if the correct amount of current is flowing into the welding transformer.

A verified preheat timer is the best way to minimize expulsion. Preheating allows the primers that we want to leave between the layers of steel, to be burned out of the way, slowly. Galvanized coatings can be vaporized (@ 1350 Degree F.), eliminating it from the weld zone before the welding takes place. The temperature is determined by the length of time we preheat the weld zone. Preheating also allows the steel to bend a little and fit perfectly before the welding power is turned on. All these things can happen only if we have preheated current verification!

Verification is the magic that makes the job go faster. The ideal welding controller validates the welding current, eliminating the problem of over welding. The technician is able to produce good welds every time without over welding and reduce the heat stress on the welding tools and transformer.

Welding tip diameter is very important. The TITE-SPOT Pliers has the welding tips sharpened to 3/16" diameter when new. The tips can be allowed to fatten to 1/4" diameter before they need to be sharpened. Welding tips have a flat face when new. This face crowns quickly with use, and this crowning effect should be encouraged. The crowning radius should be about 1.5 to 2 inches. A sharpening tool is provided with the TITE-SPOT

Pliers. (NOTE: The closed height of the welding tips is 1 1/2" when new.) Discard welding tips when closed height is 1 3/8". DO NOT SHIM WELDING TIPS

Table 7 Spot weld spacing standards

STEEL GAUGES			weld spacing		weld diameter
			2 pieces	3 pieces	
GAUGE	IN	MM	In	in	In
16	0.060	1.524	1.06	1.31	0.22
18	0.048	1.219	0.94	1.18	0.2
20	0.036	0.914	0.72	1.06	0.17
22	0.030	0.762	0.62	0.88	0.16
24	0.024	0.610	0.38	0.62	0.15

Spot weld spacing should equal or exceed the minimum standards in table.

2.3.1. Application of spot welding

Spot welding is typically used when welding particular types of sheet metal. Thicker stock is more difficult to spot weld because the heat flows into the surrounding metal more easily.

Spot welding can be easily identified on many sheet metal goods, such as metal buckets. Aluminum alloys can also be spot welded. However, their much higher thermal conductivity and electrical conductivity mean that up to three times higher welding currents are needed. This requires larger, more powerful, and more expensive welding transformers.

Perhaps the most common application of spot welding is in the automobile manufacturing industry, where it is used almost universally to weld the sheet metal to form a car. Spot welders can also be completely automated, and many of the industrial robots found on assembly lines are spot welders (the other major use for robots being painting).

Spot welding is also used in the orthodontist's clinic, where small scale spot welding equipment is used when resizing metal "molar bands" used in orthodontics.

Another application is spot welding straps to nickel-cadmium or nickel-metal-hydride cells in order to make batteries. The cells are joined by spot welding thin nickel straps to the battery terminals. Spot welding can keep the battery from getting too hot, as might happen if conventional soldering were done.

Note-Good design practice must always allow for adequate accessibility. Connecting surfaces should be free of contaminants, such as scale, oil, and dirt, for quality welds. Metal thickness is generally not a factor in determining good welds.

2.3.2. Types of Spot welders

The basic spot welder consists of

- A power supply,
- An energy storage unit (e.g., a capacitor bank),
- A switch,
- A welding transformer, and
- The welding electrodes.

The energy storage element allows the welder to deliver high instantaneous power levels. If the power demands are not high, then the energy storage element isn't needed. The switch causes the stored energy to be dumped into the welding transformer. The welding transformer steps down the voltage and steps up the current. An important feature of the transformer is it reduces the current level that the switch must handle. The welding electrodes are part of the transformer's secondary circuit. There is also a control box that manages the switch and may monitor the welding electrode voltage or current.

The resistance presented to the welder is complicated. There is the resistance of secondary winding, the cables, and the welding electrodes. There is also the contact resistance between the welding electrodes and the work piece. There is the resistance of the work pieces, and the contact resistance between the work pieces.

At the beginning of the weld, the contact resistances are usually high, so most of the initial energy will be dissipated there. That heat and the clamping force will soften and smooth out the material at the electrode-material interface and make better contact (that is, lower the contact resistance). Consequently, more electrical energy will go into the

work piece and the junction resistance of the two work pieces. As electrical energy is delivered to the weld and causes the temperature to rise, the electrodes and the work piece are conducting that heat away. The goal is to apply enough energy so that a portion of material within the spot melts without having the entire spot melt. The perimeter of the spot will conduct away a lot of heat and keep the perimeter at a lower temperature. The interior of the spot has less heat conducted away, so it melts first. If the welding current is applied too long, the entire spot melts, the material runs out or otherwise fails, and the "weld" becomes a hole.

The voltage needed for welding depends on

- The resistance of the material to be welded,
- The sheet thickness and
- Desired size of the nugget.

When welding a common combination like 1.0 + 1.0 mm sheet steel, the voltage between the electrodes is only about 1.5 V at the start of the weld but can fall as low as 1 V at the end of the weld. This decrease in voltage results from the reduction in resistance caused by the work piece melting. The open circuit voltage from the transformer is higher than this, typically in the 5-10 V range, but there is a large voltage drop in the electrodes and secondary side of the transformer when the circuit is closed

The resistance of the weld spot changes as it flows and liquefies. Modern welding equipment can monitor and adjust the weld in real-time to ensure a consistent weld. The equipment may seek to control different variables during the weld, such as current, voltage, power, or energy.for making and holding contact at the weld. Tool holders have two functions: to hold the electrode firmly in place and to support water hoses that provide

cooling of the electrodes. Weld currents can range from 4000 to 24,000 amps for different types of 1010 mild steel

A. Welding guns:portable welding guns are extensively used in mass production. Articulated guns have both arms articulated as in a pair of scissors, giving a wide aperture between electrodes, and used for welding joints of difficult of access.

Small-articulated guns are used for examples in car body manufacturing for welding small flanges and in corners and recesses.

C-guns have piston-type ram of the pressure cylinder connected to the moving electrode, which thus moves in a straight line. There is a great rigidity and a high working speed because of the low inertia of the moving parts. The electrodes are always parallel and the precision motion is independent of the arm length with easily determined point of welding

B.The Welding Cycle : the cycle of operations of most modern machines is completely automatic. Once the hand or the foot switch is pressed, the cycle proceeds to completion. The simplest cycle has one function, namely *weld time*, the *electrode force or pressure* being pre-set, and it can be illustrated by two graphs, one the electrode plotted against time and the other the current plotted against the same time axis. First the squeeze is applied and held constant. The current is switched and held for seven complete cycles (7/50s) and switched off. The pressure is held for a time, the *weld cooling* is this period. Finally the squeeze is released and the repeat cycle of operation begins again.

For more complex welding cycles, necessary when welding certain metals to give them correct thermal treatment, the graphs are more complex with up to ten functions with variable pressure cycle, and these machines are often operated from three phases. Machines for the aeronautical and space industries are specially designed and incorporate variable pressure heads and up to ten function. Most aluminum alloys lose the properties given to them by work hardening or heat treatment when they are heated. To enable the correct thermal treatment of heating and cooling to be given to them during the welding cycle three-phase machine are often employed.

C.The Transformer: The transformer steps the voltage down from that of the mains to the few volts necessary to send the heavy current through the secondary welding circuit. When the current is flowing the voltage drop the secondary may be as low as 3-4 volts and in larger machines the current can be up to 35000 A. Because of these large currents there is considerable force acting between the conductors due to the magnetic field, so

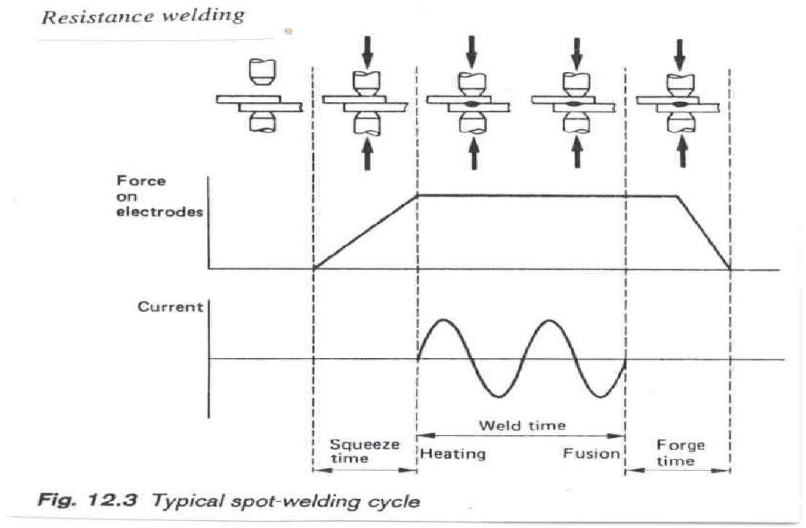


Figure 19 typical spot welding cycle

transformers must be robustly constructed or movement may cause break down of the insulation, and in addition they may be water cooled because of the heating effect of the current.

The duty cycle is important, as with all welding machines, as it affects the temperature rise of the transformer. For example, if a spot welder is making 48 spot welds per minute, each of 0.25 seconds duration, the duty cycle is (48x0.25 x 100)÷60=20%. Evidently knowing the duty cycle and welding time, the number of welds that can be made per minute can be calculated.

D.Electrodes: the electrode arms and tips, which must carry the heavy currents involved and apply the necessary pressure, must have the following properties:

- High electrical conductivity so as to keep the I^2R loss (the heating due to the resistance) to a minimum.
- High thermal conductivity to dissipate any heat generated.
- High resistance to deformation under large squeeze pressures.
- Must keep their physical properties at elevated temperatures.
- Must not pick up metal from the surface of the work piece.
- Must be of reasonable cost.

Electrolytic copper (99.95% Cu) has high electrical and thermal conductivity and, when work hardened, resists deformation but at elevated temperatures that part of the electrode tip in contact with the work becomes annealed due too the heating and the tip softens and deforms. Because of this it is usual to water-cool the electrodes to prevent excessive temperature rise.

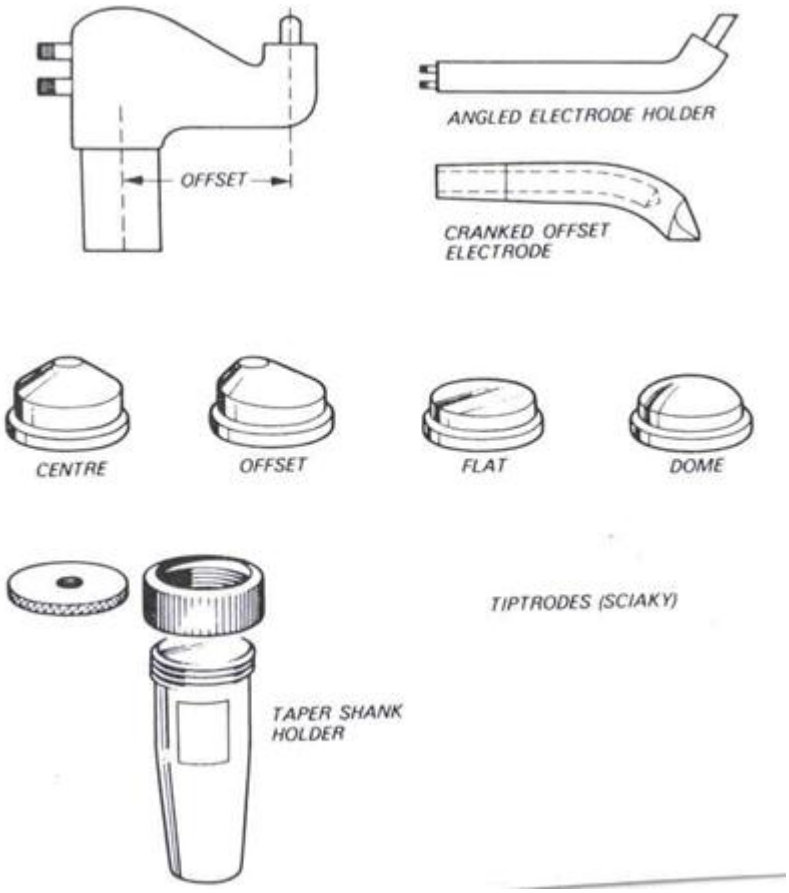


Figure 20 electrod and hol

Electrodes used in spot welding can vary greatly with different applications. Each tool style has a different purpose. Radius style electrodes are used for high heat applications, electrodes with a truncated tip for high pressure, eccentric electrodes for welding corners, offset eccentric tips for reaching into corners and small spaces, and finally offset truncated for reaching into the work piece itself.

E.Water Cooling: Adequate electrode cooling is the most essential factor to ensure optimum tip life; the object is to prevent the electrode material from reaching its softening temperature, at which point it will lose its harness and rapidly deteriorate. The

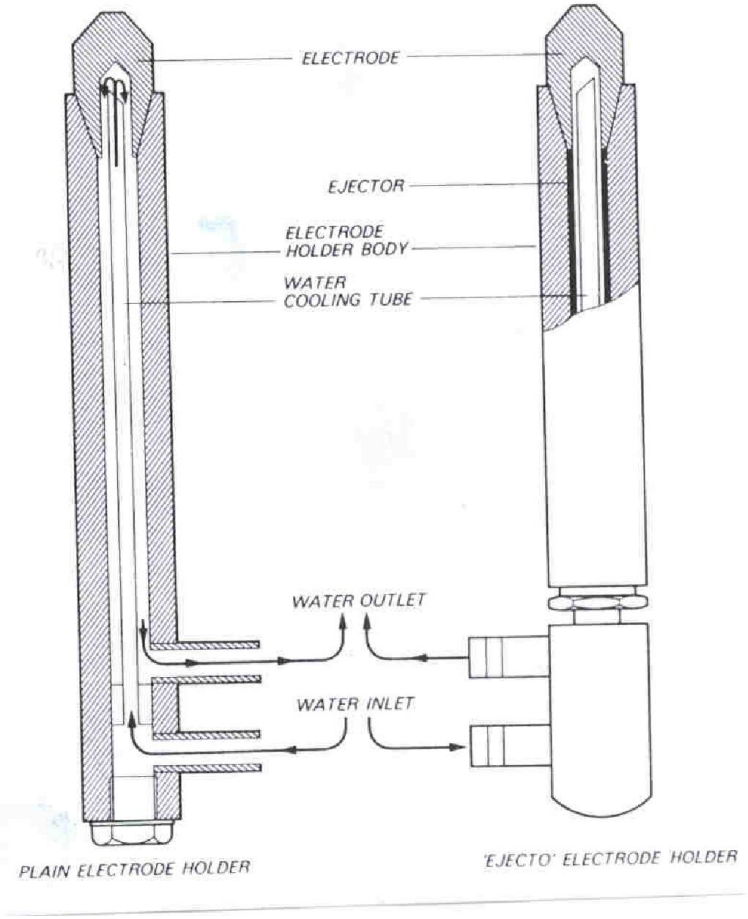


Figure 21 electrod cooling

normal cooling method is by internal water circulation where the water is fed via a central tube arranged to direct the water against the end of the electrode-cooling hole.

Electrodes are subject to great wear and tear in service due to the constant heating and cooling and varying pressure cycles. The chief causes of wear are: electrical; wrong electrode material, poor surface being welded, contacts not in line; mechanical;

electrode hammering, high squeeze, weld and forge pressures, abrasion in loading and unloading and tearing due to the parting of electrodes.

2.3.3. Effects of spot weld

The spot welding process tends to harden the material, cause it to warp, reduce the material's fatigue strength, and may stretch the material as well as anneal it. The physical effects of spot welding include internal cracking, surface cracks and a bad appearance. The chemical properties affected include the metal's internal resistance and its corrosive properties

2.3.4. Spot WELD INSPECTION:

There are three forms of weld inspection.

First there is a visual inspection; the welds should look uniform, have a small dent from the welding tip, and should have very little expulsion when the weld is formed.

The other two inspections are called destructive inspection techniques for evaluating spot welds; they are the "peel" test or "chisel" test. It is obvious that the destructive testing should be done on scrap steel before the process of welding on the vehicle is begun.

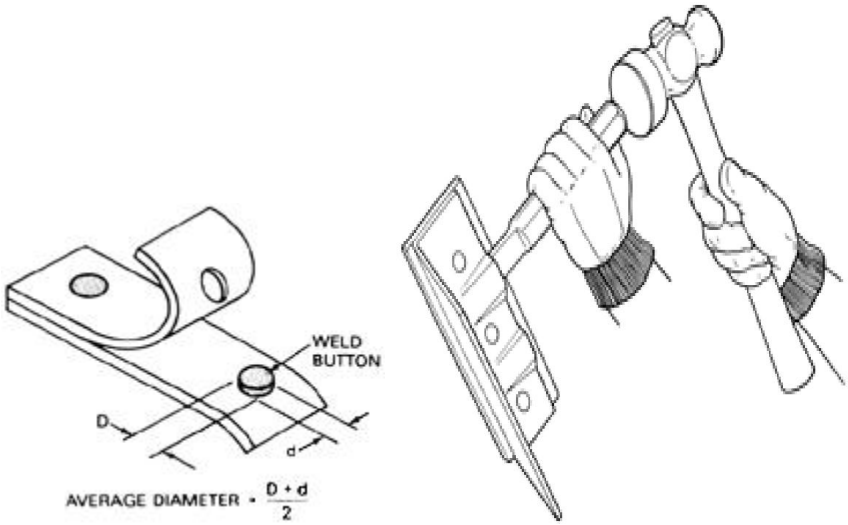


Figure 22 spot welding test

The peel test consists of peeling apart a spot weld. The button should be measured and the average diameter should be calculated.

The chisel test consists of forcing a tapered chisel into the gap on each side of the weld being tested until the weld or base metal fails. The edges of the chisel must not touch the weld being tested. This type of test is to be used when the peel test is not feasible. The button size is determined in the same manner described for the peel test.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Instruction : - discuses or write the answer for the following questions (12pts)

1. List typical Defects and Causes of welding (6 pts)

2. List Mig Welding Equipments(6 pts)

Note: **Satisfactory rating >=6 points** **Unsatisfactory <6 points**

Score = _____

Rating: _____

Information Sheet 3- Completing *Gas tungsten arc (TIG), MIG/MAG* and spot welding procedures without causing damage

3.1. MIG/ MAGwelding

Setting up the equipment and co-ordinating the welding parameters

Any joints that are MIG/MAG welded in production must also be MIG/MAG welded during repairs.Also during repairs,some resistance spot welds need to be replaced by puddle welds.

If access is difficult,or if asuitably powerful spot welder (see above)for total panel thicknesses of 3 mmor more is not available, resistance spotwelding must be partially replaced by puddle welding during repairs. Inthis case,the increased time needed and the correspondingly more demanding corrosion protection requirements, must be taken into account.

3.2. Resistance spot welding

90%ofwelding inproduction is done by resistan spot welding.As a rule,the joining technique used in production should also be used for repairs.The number and diameterof repair spotwelds must be the same as in production.Alternative joining techniques must only beused inexceptional cases.

3.3. Setting up the equipment and co- ordinating the welding parameters.

Welding repairs can only be carried out properly if the equipment isset up correctly and all the welding parameters are co-ordinated.

- Set upthe equipment as directed by the manufacturer.
- The hoses must be untwisted.
- The core must be free of abraded rod particles.
- The gas and current nozzles must be free of slag and scale residue.
- Pay attention to the quality of the welding rod and the throughput of gas.
- Ensure that the joint surface is perfect.
- Prepare a bare metal joint surface.

- Maintain the correc tgaps (formation of roots).
- The electrodes work best if their shape is standared.

– NOTE:The increased application of heat during MIGwelding destroys the welding primer/zinc layer over a much larger area than during resistance spot welding, as a Result of which much more care needs to be taken when applying anti-corrosion protection after wards.

NOTE:A test weld should always be carried out to ensure that the welded joint is not just a surface connection.

The electrical specifications (current.Attach the ground cable right next to the welding point ensure that good contact is made).

– During puddle welding start welding on the lower panel to ensur eadequate penetration.

3.4. Application and safety instructions

– Always follow the handling instructions supplied bythe manufacturer when using adhesives or sealants.

– NOTE: Observe the manufacturer's safety instructions.

Adhesives are chemicals and as such are subject to specific safety regulations.

– Bonded clinched flanges

– The bonded clinched flanges of the hood, tail gate and doors are bonded in production and during repairon many Ford models.

– These bonds are mainly for sealing purposes (anti-corrosion) rather than for adhesive strength.

– Bonds that relyon adhesive strength.

– Adhesive bondst hat relyon adhesive strength are used for adhesive strength purposes,sealing purposesand anti-corrosion purposes (e.g. Escort/Orion '91 in the rear region of the roof, near the transition to the C-pillar).

– The adhesive used for this purpose is2K epoxy resin.

Self-Check -3	Written Test

Directions: Answer the question listed below. Examples may be necessary to aid some explanations/answers

Instruction: - discuses or write the answer for the following questions (8 pts)

1. Write the Application and safety instructions for *TIG), MIG/MAG* and spot welding(8pts)

Note: **Satisfactory rating >=4 points** **Unsatisfactory <4 points**

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Operation sheet 1

OPERATION TITLE:- MIG/MAG Welding procedures (methods)

PURPOSE To repaire the vhicle dameged parts

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

Safe working area

Properly operated tools and equipments

Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

Hand tools -screw driver, wrenches, hammers

- Safety hood (face protection)
- Clamps or clips
- Welding shield

Equipments - TIG, MIG/MAG welding machine

special tools -

- Work cable & clamp assembly.
- Welding cables
- Connectors
- Cylinder stand
- Wire conduit liner

Materials -

- Spool of electrode wire
- mixture of Argon & carbon dioxide (C-25 gas) it mean 75% Carbon dioxide & 25% argon.
- Supply of shielding gas (carbon dioxide)
- Structural steel.
- Alminum sections

- Stainless steel and nickel alloys

PROCEDURE:-

Step 1 Match the welding power unit in the machine to the available in put voltage

Step 2 Adjust the shield gas pressure (gas flow rate) this is approximately 1-3/8 to 1-1/2 cubic inches per minute.

Step 3 Attached the clamp to clean metal near the weld site it completes the welding circuit from the machine to the work & back to the machine.

Step 4 Adjust the wire feed rate of the machine have.

Step 5 Adjustment of welding current, this affects the base metal penetration depth, the speed at which the wire is melted, arc stability, & the amount of weld spatter.

Step 6 As the electrical current is increased the penetration depth excess metal height & bead width also increases.

Step 7 Arc voltage adjustment good welding results depend on a proper arc length. The length of the arc is determined by the arc voltage

When the arc voltage is high, the arc length increases the penetration is shallow, & the bed is wide & flat.

When the arc voltage is low, the arc length decreases penetration is deep, and the bead is narrow & dome shaped.

The tip to base distance is an important factor in obtaining good welding results.

The standard distance is approximately 6.35mm –15.87mm (1/4-5/8inc).

If the tip of base metal distance is too long the length of wire protruding from the end of the gun increases & becomes preheated which increases the melting

speed of the wire. Also the shield gas effect will be reduced if the tip to base metal distance is too long.

- If the tip to base metal distance is too short, it becomes difficult to see the progress of the weld because it will be hidden the tip of the gun.

PRECAUTIONS:-

Wear working cloths which properly fit with your body

Make working area hazard free

Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA:

Assured performing of the activities correctly accordance with the given procedure mentioned above.

Operation sheet 2

OPERATION TITLE:- **Setting up spot welding equipment for use and welding procedure**

PURPOSE: **Setting up spot welding equipment for use** to repaire the vhicle dameged parts

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

Safe working area

Properly operated tools and equipments

Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

Hand tools

- screw driver, wrenches, hammers
- Safety hood (face protection)
- Clamps or clips
- Welding shield

Equipments spot welding machine

special tools

- -Work cable & clamp assembly.
- -Welding cables
- -Connectors
- -Cylinder stand
- -Wire conduit liner
- -Welding guns
- -Welding Cycle

- The Transformer
- Water Cooling

Materials -

A power supply

- An energy storage unit (e.g., a capacitor bank),
- A switch,
- A welding transformer, and

The welding electrodes

PROCEDUR-

Step1 with the equipment switched off, check that tips are aligned and correctly shaped

Step 2 switched on the main supply and check that the main light is red on

Step 3 switch function selection switch to spot welding

Step 4 switch on spot rite control and check that the ready light is on

Step 5 test earth leakage unit by pressing the test button

Step 6 set spot size to zero

Step 7 Make splash less weld by selecting the lowest heat and the longest time setting to make the desired size of weld nugget.

Step 8 make two welds are approximately 51 mm apart

Step 9 increase the spot size setting from zero in single steps and make five trial weld in each setting

Step 10 Increase the heat step by step to reduce the actual weld time until splashing occur then set back the one step to stop splashing. the equipment is now fully set

Step 11 Prepare the panel surface by removing any paint material covering the surface to be welded. this is a key factor to good quality spot welding/

Step 12 Obtain the correct adjustment of welding gun, electrods and arms.

Step 13 Determine the suitable pitch for the panel assembly to be welded to obtain maximum strength.

Step 14 Make sure that the correct distance is set from the edge of the sheet metal panel to the nearest spot weld

Step 15 thickness of the sheet metal to be welded

Step 16 accessibility of the parts to be welded

Step 17 State of the sheet metal surface to be welded. It must be as clean as possible and any rust or paint work must be removed

PRECAUTIONS:-

Wear working cloths which properly fit with your body

Make working area hazard free

Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA:

Assured performing of the activities correctly accordance with the given procedure mentioned above.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hour.

Task 1 Perform Mig/Mag Welding Procedures (Methods)

Task 2 Perform spot Welding Procedures (Methods)

LG #29	LO #3- Clean up work area and maintain equipment

Instruction sheet

- This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:
- Collecting and storing *materials* that can be reused
- Removing Waste and scrap by following workplace procedures.
- Cleaning and inspecting equipment and work area for serviceable conditions
- Identifying and tagging unserviceable equipment
- Completing operating maintenance
- Maintaining Tool in accordance with workplace procedures and Repair methods

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Collect and stor *materials* that can be reused
- Remove Waste and scrap by following workplace procedures.
- Clean and inspect equipment and work area for serviceable conditions
- Identify and tagg unserviceable equipment
- Complet operating maintenance
- MaintainTool in accordance with workplace procedures and Repair methods

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Collecting and storing *materials* that can be reused

1.1. Collecting and storing material

The proper care and storage of materials, tools and equipments are not only the concern of the management but of the workers who use the equipment.

A major responsibility of the technician is to ensure that materials, tools and equipment are maintained in a good condition and are readily available when required for the various work activities. Faulty tools and equipments are a common reason for delays on technical activities.

Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but

Figure 23 material storing

Fig 16 material storing

they should still be readily available when required. Stored materials should allow at least one meter (or about three feet) of clear space under sprinkler heads

proper storage of tools, materials and equipmentsImportance of proper storage of tools and equipments .It is important factor for safety and health as well as good business.Improves appearance of general-shop and construction areas.Reduce overall tool cost through maintenance.This also ensures that tools are in good repair at hand.Teaches workers principles of tool accountability.

Pointers to follow in storing tools and equipmentsHave a designated place for each kind of tools.Label the storage cabinet or place correctly.Store them near the point of use. Wash and dry properly before storing.store sharp edge materials properly when not in use with sharp edge down.Put frequently used items in conveniently accessible conditions. Gather and secure electrical chord to prevent entanglement or snagging.Cutting boards should be stored vertically to avoid moisture collection Metal equipments can be stacked on one another after drying.Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

1.2. Proper storage of material to reused

One of the responsibilities of a shop instructor/trainer is to organize and handle storage in order to protect tools equipments and materials against loose and deterioration. These, the following factors should be given due consideration.

Accessibility:- classification and making

Ease of handling :- based on the weight and bulk of the piece

Inventorying:- protect against un authorized withdrawals of materials

Safety Procedure: - un authorized usage and un necessary damage or deterioration.

However general storage should be:-

- Convenient storage
- Safe storage
- Visible storage

i. Convenient storage

The material must be stored correctly to minimize the labor required for:-

putting the material in storage maintaining the material in good order.

issuing materials quickly and orderly accounting for material

inspecting the quality and quantity

ii. Safe storage

Materials must be stored safely to prevent

- loose
- breakage
- spoilage by
- sun light
- heat
- cold
- dampness
- insects
- spontaneous combustion

iii. Visible Storage

Materials when stored should as far as possible be visible:-

- to reduce duplication
- to help maintaining adequate supplies

- to permit quick check and inspection

NOTE:-A problem of major importance in training center shop is the storage of tools, machines, equipments and accessories. In solving this shop trainer apply the practices commonly found in industry.

Machine storage

-central tools room

-separate facilities convenient to particular machine

Tools storage

-tray

-tools box/kit

-hooks (against inclined tool board, in cup board and on wall)

-compartment to fit in drawer and in rack

-hole to fit part of the tool as drill bits, chiseles and welding machine accessories

: - The place where each tools belong should be identified. This may be done by

-A symbol letter or number

-A painted outline

-Name of the tool painted over or under the position

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction : - give short answer for the following questions(10pts)

1.List four importance of proper storage of tools and equipments (4 pts)

2.List general storage classification(6pts)

Note: **Satisfactory rating - 5 points & above** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 2- Removing Waste and scrap by following workplace procedures

2.1. Waste Disposal Practices

There are eight major groups of waste management methods, each of them divided into numerous categories. You can start using many techniques right at home, like reduction and reuse, which works to reduce the amount of disposable material used.

- **Methods of Waste Disposal**

I. **Landfill**:- which is the most popularly used method of waste disposal used today. This process of waste disposal focuses attention on burying the waste in the land

II. **Incineration/Combustion**:- which is a type disposal method in which municipal solid wastes are burned at high temperatures so as to convert them into residue and gaseous products. .

III. **Recovery and Recycling**:- It is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel.

IV. **Recycling** is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Recycling is the third component of Reduce, Reuse and Recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce volume of landfills, reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use.

V. **Plasma gasification**:- It is another form of waste management. Plasma is a

primarily an electrically charged or a highly ionized gas. Lighting is one type of plasma which produces temperatures that exceed 12,600 °F .

With this method of waste disposal, a vessel uses characteristic plasma torches operating at +10,000 °F which is creating a gasification zone till 3,000 °F for the conversion of solid or liquid wastes into a gas.

Trainers are concerned how to handle the disposal of the following three types of materials or tools or equipments.

Scrap:-it is an item or equipment which becomes salvaged after giving service for ample period of time

Surplus:-this refers to the existence of items or equipments in excess of the requirements. Materials or equipments become obsolete as a result of change in technology.

Obsolete materials/equipments: - .materials or equipments become obsolete as a result of change in technology.

There are three ways of disposing materials. They are:-

1. Transferring to another equivalent organization
2. Selling
3. Discarding the material/equipments

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction i: - discuses or write the answer for the following questions (6 pts)

1. List five waste disposal methods (6 pts)

Instruction ii: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (4 pts)

1. disposing materials can be desposed in way of ----------

a) Transferring to another equivalent organization
b) Selling
c) Discarding the material/equipments
d) all

Note: **Satisfactory rating >=5 points** **Unsatisfactory < 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 3- Cleaning and inspecting equipment and work area for serviceable conditions

3.1. Cleaning of tools and equipments

Cleaning up is not just a measure of respect for the workspace, it also removes hazards.

Cleaning is so important because when we clean an area, we are also doing some inspection or checking of machinery, equipment, and work conditions. An operator cleaning a machine can find many mal-functions. When a machine is covered with oil, soot, and dust, it is difficult to identify any problems that may be developing. While cleaning the machine, however, one can easily spot oil leakage, a crack developing on the cover, or loose nuts and bolts. Once these problems are recognized, they are easily fixed. It is said that most machines breakdowns begin with vibration (due to lose nuts and bolts), with introduction of foreign particles such as dust (due to the crack on the cover, for instance), or with inadequate oiling and greasing. For this reason cleaning is useful to make discoveries while cleaning machines.

Layer of oil, grease and dirt gets coated to the tools and equipment with time and usage. Before performing in a maintenance work on the tools and equipments the unwanted layer should be removed. This can be done by hand or by means of certain cleaning methods (using cleaning solvent compressed air etc).

In order to produce a strong weld joint the surface of the metal must be free from rust, oil &paint. in order to clean these use the following tools.

- Wire brush:- a steel wire brush is used for cleaning the work & weld
- Chipping hammer:-is used to remove burrs & slag from the weld deposit.

For the other tools used for holding the work by the hand during welding are:-

- Tongs:- are used for handling pieces of hot metals
- Clamps:-are used to hold work piece during welding.
- Jig& fixtures: - are used to position the work when welding is done.

3.1.1. Kinds of Cleaning Solvents

Solutions are homogeneous mixture of two or more components. They can be gaseous, liquid or solid. When we speak of a solution, we usually think of a solid dissolved in water. While water is the most common solvent, other liquids are frequently employed as solvents for certain substances for example wax maybe dissolved in gasoline. The dissolved material in a solution is termed as solute (e.g. wax) while the dissolving medium is called solvent (e.g. gasoline). However, the term can be interchanged depending on which substance is of greater amount.

Solvent is a component of a solution that dissolves solute and is usually present in large proportion or amount. It can be classified as polar or non polar. Polar solvents are solvents which dissolve/are soluble in water; while non polar solvents are solvents which do not dissolve/are insoluble in water.

Solvents usually used for cleaning in automotive shops are: water, gasoline, kerosene, thinner and detergent soap.

Table 8 kinds of cleaning solvents based on their solubility in water.

Cleaning Solvents	Solubility in Water	Polar	Nonpolar
water	soluble	x	
gasoline	insoluble		x
kerosene	insoluble		x
thinner	insoluble		x

detergent soap	soluble	x	

3.1.2. Properties of Cleaning Solvents

A useful generalization much quoted is that “Like dissolves like”. More specifically, high solubility occurs when the molecules of the solute are similar in structure and electrical properties to the molecules of the solvent.

When there is a similarity of electrical properties; e.g. high dipole element between solute and solvent, the solute-solvent attractions are particularly strong. When there is dissimilarity, solute-solvent attractions are weak. For this reason, a polar substance such as H2O usually is a good solvent for a polar substance such as detergent soap but a poor solvent for a non polar substance such as gasoline.

Uses of Cleaning Solvents

Table 9 Uses of Cleaning Solvents

Cleaning Solvents	Uses
1. Gasoline	- It is used to wash oil/greasy tools/equipment.
2. Diesoline	- It is used to wash oil engine, transmission and other parts of the vehicle.
3. Kerosene	- It is used to remove dust, grease oil, paint, etc.
4. Thinner	- It is used to remove spilled paint on the floor, walls and tools.
5. Soap and water	- It is used to wash/clean upholstered furniture such as seats, tables, cabinets, etc.

3.1.3. Occupational Health and Safety Practices in Handling Cleaning Solvents

A great percentage of eye injury and cuts results from a disregard for the simplest of rules in handling cleaning solvents. You should never use compressed air to clean your clothes, hands or body. The pressure could cause the cleaning solvents and dirt particles to penetrate your skin, resulting in infection and /or blood poisoning. Do not use compressed air to clean an object immediately after it has been removed from a hot cleaning tank. First, rinse the cleaning solvents away with water. Do not use carbon tetrachloride as a cleaning solution. The fumes, when inhaled can cause serious internal injury and possibly result in death. When steam-cleaning, place the object to be cleaned on a pallet and wear a face shield and rubber gloves for protection against loose debris.

If a job or cleaning task requires the use of gloves, use the appropriate gloves. Do not for instance use welding gloves when removing an object from a hot tank, or rubber gloves when welding. If you have cut, nicked, or burned yourself, or something has got into your eyes, report immediately to the first-aid person. Keep all inflammable cleaning solvents in closed tin containers and whenever possible, store them in a separate area.

3.1.4. Clean up procedures

- Clean up every time whenever you leave an area, including sweeping the floor.
- Clean and return all tools to where you got them.
- Use compressed air sparingly; never aim it at another person or use it to clean hair or clothes.
- Shut off and unplug machines when cleaning, repairing, or oiling.
- Never use a rag near moving machinery.
- Use a brush, hook, or a special tool to remove chips, shavings, scraps etc. from the work area. Never use the hands.
- Keep fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc.

- Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.
- Mop up spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

3.2. Inspection of work tools/equipment

The purpose of inspection is to identify whether work tool/equipments and working area can be operated, adjusted and maintained safely. Not all work area, tools/equipments needs formal inspection to ensure safety and in many cases a quick visual check before use will be sufficient. However inspection is necessary for any work area, tools/ equipments where significant risks to health and safety may arise from incorrect installation, reinstallation, deterioration or any other circumstances. The need for inspection and inspection frequencies should be determined through risk assessment.

3.2.1. Importance of inspection

As an essential part of a health and safety program, workplaces should be inspected. Inspections are important as they allow you to:

- listen to the concerns of workers and supervisors
- gain further understanding of jobs and tasks
- identify existing and potential hazards
- determine underlying causes of hazards
- monitor hazard controls (personal protective equipment, engineering controls, policies, procedures)
- recommend corrective action

3.2.2. Inspection Procedures

When conducting inspections, follow these basic procedures:

- Draw attention to the presence of any immediate danger--other items can await the final report.

- Shut down and "lock out" any hazardous items that cannot be brought to a safe operating standard until repaired.
- Do not operate equipment. Ask the operator for a demonstration. If the operator of any piece of equipment does not know what dangers may be present, this is cause for concern. Never ignore any item because you do not have knowledge to make an accurate judgment of safety.
- Look up, down, around and inside. Be methodical and thorough. Do not spoil the inspection with a "once-over-lightly" approach.
- Clearly describe each hazard and its exact location in your rough notes. Allow "on-the-spot" recording of all findings before they are forgotten. Record what you have or have not examined in case the inspection is interrupted.
- Ask questions, but do not unnecessarily disrupt work activities. This may interfere with efficient assessment of the job function and may also create a potentially hazardous situation.
- Consider the static (stop position) and dynamic (in motion) conditions of the item you are inspecting. If a machine is shut down, consider postponing the inspection until it is functioning again.
- Discuss as a group, "Can any problem, hazard or accident generate from this situation when looking at the equipment, the process or the environment?" Determine what corrections or controls are appropriate.
- Do not try to detect all hazards simply by relying on your senses or by looking at them during the inspection. You may have to monitor equipment to measure the levels of exposure to chemicals, noise, radiation or biological agents.
- Take a photograph if you are unable to clearly describe or sketch a particular situation

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided

Instruction I: - chose and write the letter of the correct answer on the space provided or on the separate answer sheet (4pts)

1. The following are importance of inspection **except** (4)

a) listen to the concerns of workers and supervisors

b) determine underlying causes of hazards

c) recommend corrective action

d) increase cause of hazards

Instruction III: - match the items from column "B "with that of column "A" and write the letter of the correct answer on the space provided or on the separate answer sheet (10 pts)

"A"	"B"
-----1. kerosene	A. used to wash oil/greasy tools/equipments
-----2. Gasoline	B. used to wash oil engine, transmission and other parts of the vehicle
-----3. Diesoline	C. used to remove dust, grease oil, paint, etc
-----4. Thinner	D. used to wash/clean upholstered furniture such as seats, tables, cabinets, etc
-----5. Soap and water	E. used to remove spilled paint on the floor, walls and tools.

Note: **Satisfactory rating >=points** **Unsatisfact <7points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 4- Identifying and tagging unserviceable equipment

4.1. TAGS

The use of tags is considered an administrative control and as such only provides limited protection to people and plant; therefore in all cases a physical isolation must be used in conjunction with a tag to prevent the accidental activation of an isolation point.

4.2.3. Attaching the Tag

The person attaching the tag must completely fill the tag with the following information:

• Name & company of person placing tag

• The classification/department the person works for

• The date that the tag was placed

• The equipment / plant the tag was placed on

• Contact number

• Work order / job number if applicable

• Signature

It is important to clearly identify the exact piece of equipment that the tag and lock was placed on to allow identification of those personnel working on the plant.

Depends on what you need it for. You can include a stub to give to your customers, or feature numbering so you can easily track each defective part. Choose materials with a

bit more durability if you'll be working outside, replace old tags, or fasten your tags to something new.

We specialize in Repair Tags and we stock several different options for whatever suits your space. Check out our repair tag material guide to compare.

All tags feature smudge-proof surface. Write your information with a pen, pencil, or marker.

Bright colored repair and inspection tags with bold, legible prints display and highlight vital information.

Order tags with our handy Tag-in-a-Box® for convenient storage and dispensing of tags. Just pull and tear!

Looking for the right fit? Get a custom design. Our customer service staff is happy to help you find what you need

Self-Check -4	**Written Test**

Directions: Answer the question listed below. Use the Answer sheet provided

Instruction : - discuses or write the answer for the following questions (6)pts

Mention six information must completely fill the tag during a person attaching the tag (6 pts)

Score = _____

Rating: _____

Note: **Satisfactory rating >=3** **Unsatisfactory <3 points**

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

Information Sheet 5- Completing operating maintenance

5.1. Introduction To Tools And Equipment Maintenance

Maintenance is controlling the condition of tools, machines and equipments against deterioration .there are different failure modes and their behavior in time is met with different maintenance strategies

All tools, equipment and vehicles must be properly maintained so that workers are not endangered. Construction regulations require inspections of vehicles, tools, machines and equipment before use.

components of maintenance program

A maintenance strategy includes procedures as well as corrective and preventive maintenance

Inspections ensure that tools and equipments are operating correctly. Safety inspections ensure the tools/equipments are safe for both patients and operators.

Corrective maintenance (cm) restores the function of a failed device and allows it to be put back in to service.

Preventive maintenance (pm) aims to extend the life of the tools/equipment and reduce failure rates.

Preventive maintenance is the systematic care and protection of tools, equipment, machines and vehicles in order to keep them in a safe, usable condition, limit downtime and extend productivity. We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury. The successful maintenance program is:

well organized and scheduled,

controls hazards,

defines operational procedures, and

trains key personnel

5.1.1. Maintaining Equipments/Machines

The following are some of machines / equipment maintenance strategies.

1. Preventive maintenance
2. Predictive maintenance
3. Break down maintenance

1. Preventive maintenance

Understood as periodic or schedule activates in which the main objective is the direct prevention of modes or defects. It includes

- Periodic lubrication
- Inspection
- Cleaning
- Testing
- Charging
- Draining
- Balancing
- Overhauling
- Repairing
- Adjusting
- Varnishing
- Replacement

2. Predictive maintenance

Is a periodic inspection followed by replacement or overhaul if incipient defects are detested? This method does not directly reduce the deterioration rate but indirectly control the consequences of accidents, breakdowns, malfunctions, and general troubles .It involves the observer's sense of seeing, hearing, feeling and smells.

This strategies dictates a continues search for defects i.e. continues monitoring of machinery /equipment conditions and performance coupled with continues feed back.

3. Break down maintenance

Is the maintenance activities necessary to restore machines and equipments back to service after failure modes developed which were:-

Preventable but not prevented

Preventable but not predicted

Predicted but not acted upon

Not preventable or predictable

In order to carry out successful maintenance work every machines or equipments should have a history card on which all testes and repairs are recorded.

Note:-in technical institution the development of these attitudes is no less important. After the installation of the required equipment, it becomes the trainer's responsibility to keep the machines, instruments…etc in condition for effective use. This involves constant checking as well as minor repairs. The following suggestions will prove to be most helpful in maintaining equipment in excellent working condition and there by demand a minimum of repairs

1. Lubriction

The lubrication system of all machines should be checked before each period of use .to do it effectively ,trainee should be assigned the specific responsibility and should be closely supervised by the instructor(trainer)

2. Machine/Equipment cleaning

All machines and equipment should be cleaned at the end of each period of use. Electrical and electronics related instruments should not be exposed to dust and moisture.

3. Machine/Equipment Testing

All machines and equipment should be tested and adjusted periodically as much of the actual work as possible

4. Repairs

Minor repair should be done promptly by the trainee if possible or under the trainees' supervision.

5. Safety

Safe working conditions should be maintained through the trainees' safety committee.

Maintenance of Tools

To guard against accident and provide effective means for work, tools must be kept on good working condition .Good work can not be produced with dull or in appropriate tools. Proper tools maintenance maybe accomplished by:-

1. Regular Sharpening

A. tools to be issued from tools room only when sharp

B .tools in individual kits kept sharp by the one to whom they are assigned.

2. Re-conditioning before tools are in use again

A. handles broken or loose

B. defective parts replaced or repaired

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Instruction : - discuses or write the answer for the following questions (10 pts)

List four successful maintenance program (4 pts)

Write 3 components of maintenance program (6 pts)

Note: **Satisfactory rating >=5** **Unsatisfactory < 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 6- Maintaining Tool in accordance with workplace procedures and Repair methods

6.1. Maintaining Tool and Repair methods

Tools need to have enough space to be operated safely and not endanger the operator or other people in the space. People need to concentrate when trying new tools, especially ones that can injure. Make sure there is enough real estate to use a tool safely. Work areas need to be well lit and clean. Ventilation and/or air filtering is required for many tools.

The equipment itself needs to be as safe as possible. Tools should be well maintained and not have safety features removed or defeated. This is especially important when using second-hand tools that might not have a perfectly safe heritage. When acquiring new tools consider spending the extra money on models with advanced safety features, such as a Saw Stop table saw.

Make well-stocked first-aid kits visible and easily accessible throughout your space. Post clear and visible warning signs on all equipment and where necessary.

Provide personal safety equipment such as goggles, earplugs, gloves, etc. to those who don't have their own.

Accidents may happen. They probably will, and let's hope they are all minor. Nonetheless, do make sure that there is a legal entity that owns the space so that the effects of a serious injury don't extend the horror with legal ramifications.

Self-Check -6	Written Test

Directions: Answer the question listed below. Use the Answer sheet provided in the next page:

Instruction: chose and write the letter of the correct answer on the space provided or on the separate answer sheet (2pts)

---

1. Which of the following are **wrong** during maintaining tooling
   a) Tools not endanger the operator or other people in the space.
   b) The tools itself not needs to be as safe as possible
   c) Tools should be well maintained and not have safety features removed or defeated
   d) Tools need to have enough space to be operated safely

Note: **Satisfactory rating >=1** **Unsatisfactory <1**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 1

OPERATION TITLE:-Storing/arranging tools and shop equipments

PURPOSE:- For safety and health as well as good business. and for Reducing overall tool cost through maintenance.

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

Safe working area

Properly operated tools and equipments

Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

Hand tools -screw driver, wrenches, hammers etc

Equipments - floor jack, hydraulic crane etc

special tools - torque wrench etc

Reused materials

PROCEDURE:-

Step 1 Design place for each kind of tools.

Step 2 Label the storage cabinet or place correctly.

Step 3 Store them near the point of use.

Step 4 Wash and dry properly before storing.

Step 5 Store sharp edge materials properly when not in use with sharp edge down.

Step 6 Put frequently used items in conveniently accessible conditions.

Step 7 Gather and secure electrical chord to prevent entanglement or snagging.

Step 8 Cutting boards should be stored vertically to avoid moisture collection

Step 9 Metal equipments can be stacked on one another after drying.

Step 10 Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

PRECAUTIONS:-

Wear working cloths which properly fit with your body

Make working area hazard free

Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA:

Assured performing of the activities correctly accordance with the given procedure mentioned above.

Operation sheet 2

OPERATION TITLE:- Cleaning work shop area

PURPOSE:- For safety and health as well as good business.

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

properly sorted working area

Properly operated tools and equipments

Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

Hand tools -brush / ascopa etc

Equipments - air compressor etc

water, solvent, etc

PROCEDURE:-

Step 1 Clean up every time whenever you leave an area, including sweeping the floor.

Step 2 Clean and return all tools to where you got them.

Step 3 Use compressed air sparingly; never aim it at another person or use it to clean hair or clothes.

Step 4 Shut off and unplug machines when cleaning, repairing, or oiling.

Step 5 Never use a rag near moving machinery.

Step 6 Use a brush, hook, or a special tool to remove chips, shavings, etc. from the

work area. Never use the hands.

Step 7 Keep fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc.

Step 8 Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.

Step 9 clean up and dry spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

PRECAUTIONS:-

Wear working cloths which properly fit with your body

Make working area hazard free

Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA:

Assured performing of the activities correctly accordance with the given procedure mentioned above.

LAP Test	Practical Demonstration

Task 1 Collect and store material that can be reused

Task 1 Clean and inspect equipment and work area for serviceable conditions in accordance with workplace procedures.

Task 2 Tag unserviceable equipment and identifying faults in accordance with workplace requirements

Reference Materials

Book:

James E.Duffy,Auto repare technology 5th edition(2009.)

Der Yehia M. Youssef ,Advanced joining procese IM E 18-JuL-17

Jack Erjavec,Automotive Technology A Systems Approch 5th Edition(2009.)

Auto Body Repair Mannual And Spesfic Information

WEB ADDRESSES

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